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No. 1, Vol. VIII. New Series.] JANUARY 1, 1842. [Whole No. 397. Vol. XIV.

The commencement of another half yearly volume gives us the privilege which we assume only on such occasions of speaking of ourselves,—our labors for the time that is past, and our hopes and fears for the future. In doing this, we shall speak in plain terms, and relying upon the good sense of our subscribers, we trust we shall not be accused of egotism.

At the commencement of the past volume, our readers will remember that our Journal was much behind its regular time of publication. The cause of this delay was solely *want of means*. Matter was not, and never is wanting,—but without money, we can never get on,—paper must be purchased,—the printing must be paid for, and last, but not least, is our rent. If we were behindhand in fulfilling our engagements, our subscribers were still more so;—if we had not wherewithal to pay the actual expenses of publication, to say nothing of recompense for our own labor, how could we be expected punctually to perform our appointed duty. In the face of all this discouragement, we made the effort, and by the punctuality of *some* of our subscribers, we made the effort to satisfy *all*. The volume has been completed, and the latter numbers appearing at the proper time, we are able punctually to commence the new volume. It will be seen on reference to the pages of the volume completed, that nearly one half is composed of new and original, and we hope, interesting matter. It must be recollected that the information thus embodied, is prepared at no small cost of time and labor, and contains, generally speaking, the result of experience and intelligence collected from various quarters, and not to be obtained elsewhere.

We have thus, in good faith, endeavored to fulfill our portion of the contract between ourselves and subscribers;—it only remains for them *punctually* and *fully* to fulfil theirs—which is *to pay us five dollars yearly, in advance*, and as those who have neglected to pay for one, two or three years past, can no longer pay in advance for what they are in arrears, we shall be perfectly satisfied upon receiving their past dues in full and the advance for the new volume. If our journal is the means of doing any good in the cause for which we have so long labored, *it must be supported*, if not, we must withdraw from the field, and when the prospect is improving, suffer the mortification of seeing others reap the fruit of our labors. We confess that such complaints are unpleasant, but they are quite as much so to us as to others. Much as we desire the gratification of forwarding the cause of internal improvement, we have duties to ourselves and others, which are imperative and *must* be fulfilled.

But while we are *bound* to make known our disappointments and complaints, we are equally bound to express our deep feelings of obligation to those of our friends, who, not only have punctually paid their dues, but have also given us their advice and assistance. To those gentlemen who have been so kind as to contribute their share to our pages, we are happy in being able to tender publicly our hearty thanks and expressions of regard. To those personal friends, who have ever been present with counsel and assistance, we owe this acknowledgement of their labors, which have been called forth by their earnest and disinterested attachment to the cause, rather than by any merit of our own.

To the members of the Profession of Civil Engineers throughout the United States, we beg leave to address a few remarks:

Up to this time there has been no organization of the profession, and from the infancy of the railroad cause, our journal has been the only means of inter-communication in existence, and although not accredited as such, it has nevertheless been regarded by many in that light. Whether we have entirely satisfied their expectations, is for them to determine. If we have ever failed, it has been rather from the want of *means* than of *will*.

The present period is remarkable for the intense interest excited in the public mind, upon the subjects with which we deal, and the desire for, and want of correct and authentic information, is universal. Our country is yet young and growing, and many generations must elapse before the absolute necessity for great public works shall have permitted the equilibrium between the demand and the supply to be reached. In this state of things, the reputation and well-being of the profession is in its own hands, and in proportion to the exertion will be the reward. To supply the demand for information is the first object to be attained. Many points of practice, peculiar in their relations to our own country, have remained undiscovered. Many of the data upon which future labors must be built, are yet undetermined or even unknown. The subject of construction peculiar to our public works, may profitably receive much attention. The nature and preparation of materials—the effects of climate, both destructive and preservative, need far more observation and experiment before the best effects are produced. The economical relations of lines of travel, and the character of the means of transport, embracing generally—the "laws of trade," particularly—the subject of fares, of public accommodation, of management, and of the force and capacity of the motive power—have already been discussed, but yet are by no means fully determined; and the united labors of the profession are required, to give the light that is needed upon these and the other topics mentioned.

We therefore call upon Civil Engineers generally, and, as members of a common society, to contribute each in his own line, the results of observation, experience or reflection, not only upon a few, but upon all branches of their duties. And in doing so, we desire them to consider the American Railroad Journal as their organ for communication and discussion with each other, and their representative and advocate, with the public in general. In making this request, we candidly admit, that we are alike desirous of advancing their interests and our own, and if any claim is to be urged for the privilege of performing services, the benefits of which are intended to be mutual, we rest that claim upon the long and unremitting exertions of the oldest railway journal in existence, either here or in Europe.

In making these remarks, we trust that our candour will be taken as a measure of our sincerity, and returned by our subscribers with a promptness, which we in like manner will consider as an evidence of their good will, and in proportion to which, will be the exertions and cost which we are prepared to expend upon our journal.

The receipt of the pamphlet of Mr. Ellet on the railroads of the United States, has rendered it necessary that an immediate notice should be made. We are sorry that in this instance we can by no means admit the general correctness of Mr. Ellet's reasoning, however applicable it may have been in a few instances which have passed under his observation. The investigation into the history of railroads in our country, particularly with reference to the causes of failure in *some* cases, is not to be disposed of in a hasty manner, and unless great care be used in the selection of information, more harm than good might be done. At some other time we propose going at length into this subject, and owing to the kindness of a friend, well versed in these matters, we are able to give a notice of Mr. Ellet's pamphlet, which contains a view of the subject nearly in accordance with our own.

[For the American Railroad Journal and Mechanics' Magazine.]

EXPOSITION OF THE CAUSES WHICH HAS CONDUCED TO THE FAILURE OF MANY RAILROADS IN THE UNITED STATES.—*By* CHARLES ELLET, JR., *Civil Engineer.*

The above is the title of a pamphlet lately put into our hands, the author of which, is already well known by his treatise on the Laws of Trade. The subject as expressed in this title is so much of a puzzle, that to unravel it fully, would take too much time and labor, and we shall therefore limit our notice of Mr. Ellet's attempt principally in expressing our dissent, in a general way, from his main position, which may be expressed by the following quotations:

"If railroads do not maintain themselves, it is not because they are railroads, but because *great* railroads have been contracted where *little* ones only were required."

"I propose to place large roads and strong roads and easy grades and powerful engines *where there is a trade* to justify the necessary expenditure. But to make the provision in all cases commensurate with the duties to be performed—the trade and travel to be accommodated."

"It should therefore be the business of every company, first to ascertain the trade and travel on the line where it is proposed to operate, but self-evident as it may appear, I am sustained by the history of our improvements in asserting, *that it has never yet been observed.*"

"I put it to *one hundred* railways which are now lingering out a sickly existence, to say, under the light that experience has afforded them, whether the adoption of these recommendations would not have been their better policy."

First then, as to the real number and extent of lines which can legitimately be admitted into the category of railways. But indeed for the researches of a distinguished foreign engineer, the late Mr. de Gerstner, we should perhaps till now have been without any just idea at all of the number and character of this description of improvement in our wide spread country. After enumerating large and small, main-stem and lateral of every kind, as well in use as in progress, and in contemplation, he makes a sum total of 181. In all new inventions it is common and only fair to allow a per centage for such as must inevitably be spoiled in the making; if therefore we strike off from this enumeration a portion on this account, and another for those which have never even been begun, or are otherwise utterly insignificant in such an issue as this—we may easily reduce the number worthy of any consideration to 80. The proportion again of these that are utterly unproductive, is very few, neither are those many that have been partly paralysed, from inefficient management and a reckless competition, including some others that are only now convalescent from early bad nursing, and the growing pains of youth; but putting all these at 20, there are still left 60 railways which are in themselves eminently successful, and fully corroborative of their original principle of construction having been the right one, but which had been unfortunately overlaid in its infancy, by the collusive ignorance and selfishness *in those days*, of the three culprits named by Mr. Ellet,—the "engineer," the "president," and the "leading stockholder," to which list might be added a fourth, the "public"—whose rapacity in exactions for the right of way, then often dealt the fatal blow, when anything by accident had been spared from the cupidity of the other three. To speak of 200 railways in the United States, is, therefore, far too sweeping,—and equally so of 100 of them being failures,—which is entirely disproved, by the fact of the successful practical operation of the 60 railways just alluded to, and of double that number in England, from which ours are indeed *imitated*,—and further shows the accusation of utter recklessness conveyed in our third quotation from Mr. Ellet, to be as unfounded as it is little complimentary to the good sense of this enterprizing portion of our citizens.

It is now only a truism, to say, that the most active springs of prosperity in a community, are its facilities of intercourse, and these it has been more particularly of late, an anxious object among every people almost, to extend and improve. The degree of such improvement is of course tested, by how much cheaper, and as *the principal item* in the estimate of that cheapness, at how much *less loss of time* comparatively, it exceeds the best in actual use. It was thought the turnpike, and afterwards the Macadamized road, over which the stage coach was passed at 8 to 10 miles per hour by horse power, were great strides in land travel. On the water, however, steam powei ad been for sometime successfully introduced, (thanks to our immortal Fulton,) and thence arose the idea, and the stimulus given to an invention by which it could, with at least, equal success, be applied to land carriages. Railways had existed for a long time as an old invention in the collieries of England, to give more efficiency both to the power of man and horse,—the greatest known in those days,—and in their then incipient state, much economy resulted from them; but this was not enough, and it came to pass, that within the last few years,—and the honor may be divided between the free and restless energies of England and America,—that the locomotive was invented, and which, after successive improvements, and a truer adaptation to it of the old improvement of the railway, have now come to form together *an improvement* which has attained that degree of perfection, that with profit to its projectors, enables it to supercede all others, whose purpose may be transportation of whatever kind. To secure all this, great expense was necessarily incurred, and although the trade and travel actually existing, should be some rule for such outlay, yet the nature of this improvement carried in it, an unavoidable and large *surplus of power*, which rendered the business to be created thereby, a principal consideration in risking its construction; and the result in almost every case, has fully confirmed the justness of such an anticipation.

It is therefore that the accommodating this improvement *exactly* to the present immediate wants of the community, would be neither wise nor practicable, as most of the roads in Mr. Ellet's scale would be only to retrogade, such for instance as were only to cost $12 to $1500 per mile, with locomotives at $500 to match, on which according to our estimate, there could not be furnished as quick despatch and as good accommodation in the long run, as from the old turnpike with good horses.

An instance where a *great* road instead of a *little one*, or rather *none at all*, would have answered better, is the case of the New York and Harlem, which, for 20 miles of single track, mostly plate rail, now costs its proprietors $83,000 per mile, and is still accumulating, which is not, however, attributable to an original defect in the principle of construction, but altogether to improvident management. An instance of another kind, is the road from Jersey City to New Brunswick, of 37 miles, of single track edge rail, which costs, with an equipment equal to all the traffic and travel between New York and Philadelphia, $52,000 per mile, including the heavy item of $10,000 per mile for the right of way, and yet yields 6 per cent. nett, on that cost. In this case, its enterprising projectors, not overlooking entirely the sufficiency of the existing travel and business, depended also on the effect of the *surplus power* which constituted so large a part of their outlay, and that they built on no fallacy in its producing a full return, it may be stated that the Newark travel alone, which was only 30,000 per annum by stage coaches, has, since the introduction of the railway in the last four years, increased to upwards of 300,000 per annum. In this ccstly item consists the vitality or creative principle of the railway, and necessary *at first* to secure the existing business, it is equally indispensable *afterwards* to provide for its future development. It admits of scarcely any medium, and is a *sine qua non* when determining on the adoption of this improvement.

Still another comparison may be made between the Schuylkill canal, which costs $38,000 per mile of itself without boats, and the Philadelphia and Pottsville railway, which costs $50,000 per mile, including cars and motive power. Is it not this additional cost which makes it the superior and cheaper work of the two? And here again its projectors, with an eye at first towards appropriating the present large trade on its line, have, in this apparent great cost, provided a reserve of power equal to the management of double that trade or more, which will be gradually accumulating upon it by its own creative principle. It is now indeed allowed, that much of the suffering and failure with many important railways, has proceeded from too cheap a construction at first.

The modifying scale required by Mr. Ellet's plan may be applicable to the steamboat from its tranferrable character, but not to the railway, which, as a fixture, must look alike to the present and the future; and the adoption of his plan, it would seem to us, instead of being consistent with the *rapid progress* and universalizing process required by the "onward" character of the age, would return us to the era prior even to the stage coach. We consider that the steamboat and railway, but particularly the latter, as the most reaching, have saved our Union, and are destined to knit us still closer. All this has been done at an immense private pecuniary sacrifice, which the General Government, the appointed guardians of the people's welfare, have only just now been willing to admit: we refer to the late reports of the Secretary of War and the Postmaster General, whose recommendations (sometime since first broached in this Journal) we trust may not go unheeded by the people's representatives to whom they are addressed.

We have thus endeavored to show that the *great* objects and purposes of the railway have been misconceived by Mr. Ellet; and so readily does error, as regards this improvement in particular, fasten itself on the public mind, that the few sentinels on its watch towers are required to be doubly on the *qui vive* to stop its passage, although so much has already been done in this way, that for all future purposes, it may be proclaimed in the ascendant, as constructed on the principle which has till now obtained; and so great have been of late the modifications in the details of construction, that a much improved structure can now be built *far cheaper* than was practicable some few years ago.

By the following report, it will be perceived that the Susquehanna division of the New York and Erie railroad is in a state of forwardness as gratifying as it is unexpected. Until reading Mr. Stuart's report, we had no conception of the rapidity with which this portion of the work—in itself a long railroad—had been advanced. Great credit is due to Mr. Stuart for his energy in pressing on the construction in an interior country, where the means for accomplishing transport and obtaining aid are not always under control.

This section has a feature as novel as it is likely to prove useful. We refer to the construction of *seventy-four* miles out of 117½, of piled road, entirely by the aid of steam pile drivers, at the moderate cost of two thousand dollars per mile, including the cost of the timber. Dependant upon this mode of construction is the great advantage that, according to the convenience and means of the company, this piling may be filled in with embankment, at a cost far less than would be required by the usual method.

We likewise note with pleasure and hail as an evidence of the approach of a just appreciation of the merits of railways in the public mind, the fact that nearly *two hundred acres* of land have been given to the company by owners in the different villages, to be used for depots and station houses. With this liberality on the part of proprietors, we doubt not will be found a disposition in others parts of the route to bestow land, both for similar purposes and for the road itself.

There is no reason why this whole section should not be finished early in the coming season, and by next fall pour down upon us the produce of this vast region, to the mutual profit of the producers, the consumers and the company, whose enterprise has already received such a grateful stimulus in the brilliant success of the portion of the road completed to Goshen.

NEW YORK AND ERIE RAILROAD.—REPORT OF THE CHIEF ENGINEER OF THE SUSQUEHANNA DIVISION, TO THE STATE INSPECTOR.

ENGINEER'S OFFICE, SUSQUEHANNA DIVISION,
ELMIRA, *December* 8, 1841.

DEAR SIR: In compliance with your request, of the 4th inst., I herewith transmit you a brief report of the state and progress of the work on the Susquehanna division of the New York and Erie railroad up to the first of this month; together with an estimate of the further expenditures, necessary for its completion:

I. Work done.

Six miles graded for *graded* road bed.

Thirth-five miles graded for piled road, before piles are driven, for the purpose of bringing the earth material to within two and three feet of the graded line.

Seventy-four miles of piles driven, sawed off and peeled, including the pilling, through about *thirty* miles, and one-half of the above grading for piled road.

Six and one-half miles of superstructure, exclusive of the iron H rail.

Six miles of iron rail delivered at Corning.

Ten bridges completed and painted, including *one* large bridge over the Chemung river, at Corning, *one* over the Conhocton, at Painted Post, and *three* over the Chemung canal and feeder.

The foundations for *fourteen* bridges completed in readiness for the superstructure, including the abutments, piers and ice breakers, for *three* of the larger class of bridges on the Chemung river, and *five* on the Canisteo.

The foundation for *twelve* bridges in part, constructed; *four* on the Canisteo river, and *one* on the Chemung.

II. Timber delivered and used in the above work.

2,100,000 *lineal feet* of piling timber, from 10 to 20 inches in diameter, and from 8 to 30 feet in length.

730,000 feet (b. m.) of ties and rails, for superstructure of road.

15,000 white elm treenails for superstructure.

90,500 *lineal feet* of square white oak timber, for foundations of bridges.

170,000 *feet* (b. m.) of white oak, and

180,000 *feet* (b. m.) of white pine plank, for bridge and culvert foundations.

400,000 *feet* (b. m.) of white oak and pine timber, for superstructure of bridges.

Total amount of timber delivered and used in the work, is 2,190,-500 *lineal feet,* and

1,480,000 feet (b. m.) with *fifteen thousand* white elm treenails, for securing superstructure to the piles.

III. Timber delivered and ready for use.

6,200,000 feet (b. m.) or sixty miles of superstructure timber for road.

500,000 feet (b. m.) of timber for the superstructure of bridges.

250,000 *lineal feet* of piles for piled road.

50,000 *lineal feet* of square oak timber for bridge foundations.

100,000 feet (b. m.) of white oak and pine plank, for bridge foundations.

70,000 feet (b. m.) of timber for the foundation of trestle bridges.

30,000 white elm treenails for superstructure of road.

Total amount of timber delivered ready for use is 300,000 lineal feet, and 6,870,000 feet (b. m.) with 30,000 white elm treenails, for superstructure.

The estimated cost (exclusive of an iron rail,) to complete the Susquehanna division is as follows, viz:

From	Hornelsville to Elmira,	59.85 miles,	-	$200,000
"	Elmira to Tioga Point	18 "	-	140,000
"	Tioga Point to Owego,	18 "	-	25,000
"	Owego to Binghampton,	21.65 "	-	85,000
	Total, -	117.50 miles,	-	$450,000

The additional cost of an iron H rail, weighing 56lbs. per yard, with the necessary castings and spikes to secure it, is estimated at $7,000 per mile, including the expense of transportation, and the workmanship requisite to place it upon the superstructure.

The right of way is obtained for a distance of about *one hundred and five miles* upon this division, of which amount, *sixty-two* miles have been deeded; embracing *six hundred and seventy acres of land, four hundred and twenty farm crossings, and forty thousand rods of fencing.* The residue is re-leased, by written agreement, but the deeds have not yet been executed.

All the timber required to complete the *piling, bridging* and *superstructure* upon this division, is under contract to be furnished before the first day of June next, and the greater portion by the first of April.

The eight steam pile drivers that have been in operation during the past season on this division have suspended work for the winter. If they resume as late as the first of April next, they will be able to drive the remaining thirty-four miles of piled road by the first of July, 1842. Only two miles of light grading for graded road, yet remains to be done, and three and one-half miles of grading for the piled road, before the piles are driven. Sixty miles of the distance piled, will not require embanking while the piles remain sound, the grade being less than three feet above the surface of the ground. The residue of the grading necessary for the piled road will be done with cars after the superstructure is laid, at a much less expense than it could be done previously by wagons or carts.

The amount of high piling and heavy embankment is greatly increased by the necessity of keeping the grades, (where the road bed occupies the bottom lands) above the river freshets; and placing the bridges over the Chemung and Canisteo rivers out of danger from the highest floods.

The road bed between Elmira and Hornelsville is prepared for the superstructure, with the exception of two miles of light grading, and about nine miles of piling. Six miles of the superstructure is laid.

From Tioga Point to Owego, the grading and piling is now completed, and the superstructure timber nearly all delivered. This superstructure is now being laid.

From Elmira to Tioga Point, and between Owego and Binghampton villages, a large proportion of the grading and piling is also completed.

The working force that has been employed during the past season, can, if the necessary funds are provided in time, finish the entire division by July 4th, 1842.

Indeed, the Susquehanna division may now be considered, at least, *two thirds* constructed, (exclusive of the cost of the iron rails) and the timber, necessary for its completion, is now more than *three fourths delivered* and *paid* for.

The total amount expended since the commencement of this division is less than eight hundred thousand dollars. Thus you will see that this sum includes the amount expended for the "*right of way*" for *one hundred and five miles*,—for *four hundred farm crossings*,—and *forty thousand rods* of fencing,—the grading and preparing for the superstructure, of over *eighty miles of road*,—including several miles of heavy grading, and protection river wall along the abrupt shores and narrows of the Susquehanna, the

Chemung and the Canisteo rivers,—and the construction of several large bridges over the two latter streams, including expensive foundations and ice-breakers, and numerous other bridges over smaller streams. Also, six miles of superstructure is laid, and the iron delivered for it, together with the timber requisite to lay over *sixty miles* additional track, and for some *fifteen* bridges of the larger class, to be constructed over the Chemung and Canisteo rivers, also, the timber necessary for *ten miles* of piled road—altogether, showing a result truly surprising, and entirely unprecedented in the annals of railroad construction in this or any other country. Of this distance, *seventy four miles of piled road* has been constructed at a cost not exceeding *two thousand dollars* per mile, including the necessary *white oak* piling timber. To have graded this same distance, by excavations and embankments for a graded road bed, with the necessary culverts and side ditches, would have required an additional sum of not less than *two hundred thousand dollars.*

Suitable grounds for passenger and freight depots have been donated to the company, by the owners of landed property in the several villages through which the road passes on this division, to the amount of nearly *two hundred acres*, varying in quantity from three to thirty acres for each depot—the estimate value of which, is from *one hundred to one thousand* dollars per acre.

It is proposed to have the materials required to construct the depot buildings on this division, delivered during the present season, and the buildings completed in July, 1842.

Respectfully submitted,

C. B. Stuart.

Chief Engineer Susquehanna Division, N. Y. & E. R. R.

To Charles Adams, Esq., *State Inspector*.

THE POSTMASTER GENERAL AND THE RAILROADS.

The report of the present Postmaster General comes to us promising better things than did that of his predecessor. In the document before us, from which we give extracts, we perceive tokens of a more liberal and enlightened policy than has hitherto prevailed. One of the chief causes of the difficulties between the Department and the railroads, is here fairly set forth—we mean the inability to reconcile the wants of the Post Office and the travelling public, as to times of starting. From the moderate tone of this public officer, and the promptness with which his overtures appear to have been met, we have reason to hope that these long desired arrangements may before long be completed.

Much attention has been excited by a proposal or suggestion in this document, and which promises to have a powerful influence upon railroads. The Postmaster General proposes to advance the credit of the United States to an amount, which, at 5 per cent., would produce an interest equal to the present annual compensation. By this means a provision will be made for the future control over the transportation of the mail, and a valuable previous consideration will be realized by the companies contracting.

This plan which has, as far as we have noticed, received general approbation, was some time since produced in this journal as a means for settling all difficulties and doing a public good. We see nothing in it at all objectionable, and we hope that Congress will think favorably of it and carry it into effect.

"The act 1838 declares that 'each railroad within the limits of the United States, which now is, or hereafter may be completed, shall be a post road;' and in that law, and the act of 1839, provisions limiting the amount beyond which the Postmaster General is prohibited from paying for the transportation of the mail on railways will be found.

"Great embarrassments to the Department have arisen in the making of contracts for the transportation of the mail with many of the railroad companies, under the laws now in force. These embarrassments arise mainly from two causes; the one, that the price which the Department is enabled to pay, whether in reference to its means or the maximum fixed by the legislation of Congress, has been deemed inadequate by many of the principal companies. The other arises from an unwillingness on the part of some of the companies to run by a schedule prescribed by the Department; prefering to run at such times as will best suit the travel upon the road; regarding, as it is natural for them to do, the carrying of the mail as secondary to the transportation of passengers. The latter evil has been particularly felt in the great southern mail, on its transit from Washington city to New York. The mail going south from New York, is necessarily thrown upon the Philadelphia and Baltimore railroad in the night, between Philadelphia and Baltimore; and the southern mail for New York is compelled to lie over twelve hours in Baltimore, unless the Philadelphia company can be induced to run that trip also in the night. This they have declined doing, unless the Department would pay them a compensation greater than is authorized by the laws of Congress. Under a hope that some arrangements could be made—to last during the session of Congress, if no longer—I addressed to the presidents of the railroad companies concerned in the transportation of the mail between the city of Washington and New York a letter, a copy of which, and the report of the First Assistant Postmaster General upon this subject, are herewith submitted.

"An anxious desire to effect some permanent arrangement with the railroad companies for the transportation of the mail, upon a basis which shall be both just and uniform, considering the nature of the service performed by each, induced me to invite a meeting of the presidents of the different companies, in the city of Washington, on the first of January next; and I am gratified at the prompt manner to which all who have been heard from have consented to attend, and a hope is cherished that some arrangement, satisfactory to all parties and beneficial to the public, may yet be effected.

"The improved mode of intercommunication by railroad and steam, operating under chartered rights granted by the States, and over which it is not pretended that the General Government, much less the Post Office Department, can exercise any control, imposes upon Congress, in my opinion, new duties an obligations, which can only be cancelled by the adoption of some measure whereby the Post Office Department may, upon adequate consideration, secure by compact the right to transport the mail in the cars of railroad companies, and at the same time give to the Department the power to control the departure and arrival of the same.

"There is now paid to the different railroad companies, annually, over $400,000 for the service, without power in the Department to regulate the travel, arrival, and departure of the mail; and constant and frequent difficulties, both in entering into and the execution of contracts, are presented.

"It has occured to me that the present was a most favorable period for the adoption of some measure by Congress, whereby to secure to the United States the right to transport the mail upon these roads in all time to come, free of any annual charge upon the Post Office Department, by the advancement of a sum in gross, which may be agreed upon, to each of these companies, or such of them as may be willing to contract. Many of the railroad companies, and some of them constituting most important links in the great chain of intercommunication between Boston and Charleston, owing to the great derangement of the monetary concerns of the world, and the depression of all State and company stocks, find themselves laboring under embarrassments and difficulties, which the aid of the General Government, applied in the way proposed, would effectually remove, and at the same time secure to the United States the advantage and the ample equivalent of transporting the mail upon these roads.

"The credit of the United States to an amount not greater than the sum necessary to produce, at five per cent. interest, the amount paid by the Post Office Department to these companies annually, would, I have no doubt, be sufficient to accomplish this desirable end. The prompt and favorable action of Congress upon this subject at the present time, would effectually secure the Government against the danger of being called upon for occasional and large appropriations to meet the balances due by the Department.

"Do I ask the United States to do more for the Post Office Department than justice would seem to demand, especially when it is remembered that the whole expense of the official correspondence of the Government and the public, and private correspondence of those entitled by law to the franking privilege, is sustained and paid by a tax upon the correspondence of the community? If by this arrangement the Department is relieved from the heavy annual charge as now rated, (and it has neither the power to lessen it nor to prevent its increase,) it may be hoped that the object so much demanded by considerations of public justice (that of reducing the tax upon the friendly and business correspondence of individuals will be attained,) and, at the same time, the usefulness of the public mail greatly enlarged and extended to those portions of the Union hitherto measurably denied the necessary mail facilities.

"If the Government was required to pay postage upon official correspondence, and if the franking privilege was abolished or reduced to proper limits, the revenue of the Department would be increased to an amount sufficient of itself to pay the interest upon the debt to be incured by the proposed arrangement, and liquidate the principal in less than thirty years.

"I respectfully submit to the President the propriety of communicating to Congress the views which I entertain and have here expressed upon this subject."

[From the Civil Engineer and Architect's Journal.]

HISTORICAL SKETCH ON THE USE OF BRONZE IN WORKS OF ART.

By CESAR DALY, *Architect.*

The exertions of the Italian artists excited general emulation throughout Europe, and in a very short time every country used bronze for the decoration of its public edifices, and to transmit to posterity the deeds of its kings and great captains Italy erected statues to the Medici and the Farnese, Spain to Philip III., Russia to Peter the Great, Sweden to Gustavus Adolphus, and England to Charles the First. Much might be said with regard to the progress of this art, but we consider ourselves obliged on account of the extent of the subject to limit it to the history of bronze in France.

It was under Louis 14th, that this art made rapid progress through the enlightened endeavors of the two brothers Keller, whose prinpal master pieces are yet to be seen adorning the royal palaces of Versailles and the Tuilleries. In 1699, Balthazar Keller cast in one piece the equestrian statue of Louis 14th, modelled by Girardon. This collossal mass was more than seven yards high, and yet weighed only 26,072 kil. (57,50 lb.) It seemed, however, as if the art of founding had only attained this state of perfection soon to fall into decadence; the equestrian statue of Louis 15th, cast by Gor in one piece, from the model of Bouchardon, and afterwards raised in the Place de la Concorde, was only 5·40 m. (17 ft. 9 in.) in height, while its weight was 29,370 kil. (64,775 lb.) During the revolutionary crisis, the only bronze work was limited to cannon; but under the Empire, bronze was again appealed to, to take its place among the other arts in representing the military triumphs of the French. Unfortunately the art had been too long neglected to allow of success, and some of the first essays were not prosperous, the statue of Desaix was a complete failure, and the Column of the Place Vendome is far from being a masterpiece of founding, According to M. Payen, to whom we are indebted for the following details, the execution of the Desaix statue was put up to contract, and it was undertaken for 100,000f. (£4,000,) a price in which the bronze was not included. The contractor gave up his bargain to a bell-founder, and he knowing nothing of the fashioning of such great works, and calculating upon the basis of his ordinary limited operations, engaged to do it for 20,000f. (£800;) but in order to economize as much as possible, he required that the sculptor should be forbidden from superintending the moulding. The most difficult hollows were filled up, in order to avoid the trouble they would occasion; an attempt was made to mould in sand with frames, furnaces were erected, and an ill-constructed scaffolding, and after many useless arrangements and expenses, the bronze was let out, and having burst the moulds, ran about. Thus the operation completely failed, a good deal of the bronze was lost, and it was necessary to begin again. The founder then tried to cast the monument in pieces, but not arranging his moulds well, nor securing a uniform mixture of the metal, the pieces produced were dissimilar. He managed however, to fit them together, but all the proportions of the figure were altered, and as these defects could not be remedied by the chisel, a most wretched monument was produced.

When the column in the Place Vendome was erected, the same faults were repeated; a bargain was made with an iron founder, who had never been engaged in bronze work, he however, had the temerity to undertake the moulding and finishing at one franc per kilo. (9*d.* per 2 lb.) The government on the other side, undertook to deliver to him in guns, taken from the Russians and Austrians during the campaign of 1805, the quantity of bronze necessary for the completion of this enormous monument. The founder used a furnace he had for casting iron, but not being aware of the phenomena of bronze casting, and urged by his vanity to attempt in the first instance the casting of several of the great pieces of the base of the column, he encountered several defeats. Each time he necessarily altered the alloy by oxydizing the tin, lead and zinc, which metals so oxydized passed into the scoriæ or were carried off by the current of warm air. He did not perceive this cause of continual loss, and continued to produce the bas reliefs; but it may be readily conceived that they contained more copper than the bronze of the guns. When the founder had got two thirds through the column, he found out that he had got no more metal, and being, according to contract, responsible for the metal delivered to him, he was at once ruined. In this lamentable situation he tried to melt up the white metal obtained from the reduction of the scoriæ and a large quantity of refuse metal which he had bought up at a low price. The bas reliefs which he obtained from the mixture of all these materials were marked with blotches and lead spots, their color from a dirty grey became quite black: the authorities refused to receive work so defective, and put his foundry under sequestration. He succeeded, after much petitioning, in obtaining a committee to examine his accounts, which was composed of two chemists, two architects, two mechanical engineers, and two founders, with an auditor of the Council of State for the chairman. The weight of each piece delivered by the founder was known; specimens were taken from them, and the proportional parts weighed, from which was made an ingot representing the mean composition of the whole column. It was then found by analysis that it contained:

Copper, - - - - - - - - -	89·440
Tin, - - - - - - - - -	7·200
Lead, - - - - - - - - -	3·313
Silver, zinc, iron, - - - - - - - -	0·047
	100

The committee then took specimens of bronze from the guns remaining in the government stores, and an ingot was formed to represent as nearly as possible the mean composition. The analysis of this ingot gave the following proportions:

Copper, - - - - - - - - - -	89·360
Tin, - - - - - - - - - -	10·040
Lead, - - - - - - - - - -	0·102
Silver, zinc, iron, loss, - - - - - -	0·498
	100

It was further known, that the law in France had fixed the composition of gun metal at 90 parts of copper and 10 of tin per cwt., but that this law was never well executed and during the revolution scarcely attended to it at all; it was also known that these foreign guns were of a more complicated and baser alloy than the French. Taking all these circumstances into consideration the committee were of opinion that the founder had produced an alloy, if not superior, at least equal, to that which had been given to him; and that he could not be charged with fraud in his contract. The chemical operations further explained the whole proceeding; by making separate analysis of the specimens of the great bas reliefs, the shaft, and the capital, it was found that the first had only 0·06 alloy per quintal; the second, particularly towards the upper part, and the third contained as much as 0·21. It was therefore evident that the founder not knowing how to manage bronze, had refined his alloy by several times re-melting, and consequently diminished the total weight, and that to make up for this loss, he was obliged to put into the last castings the white metal extracted from the scoriæ. Thus he had given bronze of too good alloy in the beginning, which had obliged him at last to make the alloy too low. The moulding of the several bas reliefs was so badly executed, that the chaser employed to go over them, removed by chiselling or filing, a weight of bronze equal to 70,000 kilo. (7 tons,) which were given to him, besides a sum of 300,000f. (£12,000) paid down.

It was certainly hard to pay so dearly for experience, but fortunately it was profitable; not, however, that all the subsequent bronze works in France have been more successful, for the founders had to submit to several severe checks, and were obliged to study the processes and proportions necessary to form a good alloy.—Thus when in 1817, Lemot was employed to cast the equestrian statue of Henry 4th, now on the Pont Neuf, he at least took the precaution to take specimens from three bronze statues of Keller at Versailles, which were the best, with regard to casting, green color, and the grain. The following is the result of his analysis:

	No. 1.	2	3	Mean.
Copper, - -	91·3	91·68	91·22	91·4
Tin, - -	1·	2·32	1·78	1·7
Zinc, - -	6·09	4·93	5·57	5·53
Lead, - -	1·61	1·07	1·43	1·37
	100	100	100	100

Lemot thought that he had gained experience enough from these analysis, but he did not escape from serious difficulties during the casting. Wishing to make use of the furnace, which had been built for casting the equestrian statue of Louis 15th, formerly in the Place de la Concorde, but the furnace not having sufficient draught for the fusion of Keller's alloy, in which there was more copper than in that of the statue of Louis 15th, he was obliged after several trials to make great changes, and still the casting did not perfectly succeed. The body of the king had several hollows in it, and the belly of the horse failed, a hole so large having been formed that it was obliged to be filled up; further 14,000 kilo. (14 tons) of oxydized rubbish was sold off.

Casting in bronze, although presenting only slight difficulties in the manufacture of objects of small dimensions, has always required greater responsibility when it is required to form considerable masses, perfectly homogeneous. The component metals are deficient in energetic affinity for each other, when in fusion tend to separate in the order of their densities, and when the less fusible begin to solidify, the others in a liquid state, rise up towards the top, where the easy oxydation of a component part of the alloy always causes the risk of refining the metal. Besides these great obstacles, others are encountered in calculating the several component parts of the bronze, where it is wished to obtain precisely the required quantity of metal for the object to be cast, also in the preparation of the model, the construction of the furnace, and the dispositions of the moulds. These and other diffiulties explain how many abortive attempts sometimes preceded in former days the casting of a large work in bronze. They point out why Falconet was 15 years casting the equestrian statue of Peter the Great, which figures on an immense monolithic pedestal at St. Petersburg; why the Keller's were 9 years casting the statue of Louis the 14th; why Bouchardon and his successor Pigalle took 8 years for that of Louis 15th, on the Place de la Concorde; why the statue of Desaix, and we may almost say the column of the Place Vendome, failed, and why the great equestrian statues we have mentioned did not come perfect out of their moulds. The statue of Peter the Great was obliged to be begun again from the knees of the Czar and the breast of the horse, to the top of the statue. Bouchardon had much trouble in restoring the delicate forms of the horse in his beautiful equestrian statue of Louis 15th, which were badly produced in the lower part, and we have related the difficulties encountered by Lemot and Piggiani in casting the statue of Henry the 4th, difficulties which lasted four years. We cannot better finish this essay than by mentioning those which have just been surmounted in casting the various parts of the July Column, and for the better effecting this we shall compare it with the column of the Place Vendome, which is the only one having any analogy to it. The Vendome Column is only coated with bronze, and the largest pieces are only five yards in extent, while each of its tambours is composed of six pieces, and the whole cost of the column in specie and metal provided by the State was two millions (£80,000.) The July Column on the other hand is entirely of bronze, and each tambour is in one piece, the base of the column extends about 16 yards, and the capital at the most extended place has the enormous dimension of 26 metres, 85 feet. This column, however, only cost 1,172,000 francs (£46,880.)

Inequalities in the thickness of the parts constitute one of the great difficulties of casting, because the thin parts cooling rapidly, and the thick parts slowly, the shrinking of the former taking place sooner than that of the latter, is apt to split the metal. It may be also conceived that the shrinking of a large object is so much more than that of a small one, as its dimensions are greater and the necessity for taking this into consideration causes a fresh difficulty in the construction of the mould, which must be calculated so as to provide for the contingency. It is easy in the same way to conceive that the least motion of the mould during the operation, will cause the required thickness to be exceeded. These considerations will explain the difficulties which had to be surmounted in casting the the several parts of the Column of July, and as to the statue, we cannot do better than republish an abstract from the report of M. Hericarb de Thury, made to the *Societe d' Encouragement*, on the improvements introduced by M. Soyez in the moulding of bronze sculptures.

"This statue 4·25 m. (14 feet) in height, supported on the toe, and bending forward, presented great difficulties in the moulding, and still greater in the casting, as the solidity of the statue depended on the extreme lightness of the upper parts, and the strength of the leg on which it is supported. Had the old methods been resorted to the figure would most probably have failed, or have been tried in several pieces: because the upper part being very thin would cool down immediately, while the lower part cooling more slowly, would have contracted on itself, leaving at the ancles an opening of about 25 millimetres (an inch,) the metal contracting from 12 to 14 millimetres per metre (½ an inch) and the statue would have undoubtedly been lost. To obviate these difficulties, M. Soyez determined upon casting it head downwards, by which he diminished the danger, I say diminished, for in this posture, the mould must have yielded, or the leg broken above the ancle. To provide for this, M. Soyez placed on each side of the foot a branch of copper 6·6 met. (26 in.) broad finishing in a strong head, so as to force the foot to contract on the knee. Further, these branches were so managed as to be rather thinner than the leg. Full success crowned the trial of this bold and ingenious innovation, the casting of this admirable statue succeeded in every detail, being perhaps the first time that a figure of this importance was cast without any defect. The thickness of the statue is from 4 to 5 millimetres (a sixth to a fifth of an inch,) in the upper part, except the wings, which are only two millimetres. The supporting leg is 55 millimetres (2¼ inches) thick, beginning from the ancle, and progressively diminishes in thickness up to the thigh."

The monument of July undoubtedly marks a new era in the history of the art of bronze casting. and places France in the first rank in its pursuit, and in order to do justice to M. Soyez, we must mention some of the improvements effected by him. This artist has got rid of the use of iron as a means of consolidating isolated parts of figures, and particularly in supporting members; he casts these parts full by turning the figure upside down, which is an important innovation. He gets over the resistance of the sand of the mould on the contraction of the metal, not only by the weight of the mould, but by the progressive tenacity of the bronze while cooling. This tenacity, which may be considered as proportional to the area of the section of the part so cast, is increased at pleasure by accessary parts placed in the mould according as they are wanted. It is thus that the Genius of Liberty was cast, having as it were a second shapeless leg placed parallel to that which supports the figure, and intended to become at the period of contraction, auxiliary to the statuary leg to which it was united by the two extremities. Thus also was cast the bent back leg of the horse of Charles Emmanuel of Savoy. In order to prevent this leg from breaking in the ham when cooling, the foot was united to the thigh by a strong tenon, which was afterwards chiselled away.

[From the Civil Engineer and Architect's Journal.]

ENGINEERING WORKS OF THE ANCIENTS.

Carthaginian engineering—Our author gives an account of several sieges by the Carthaginians in Sicily, who appear from his account to have been as skillful as the Greeks in military warfare. At the siege of Himera in Sicily, Hannibal the elder (Book 13th,) undermined the walls, supporting them with great pieces of timber, which being set on fire, a great part of the walls suddenly fell down.

In the 20th book, in the account of the expedition of Agathocles into Africa, there is a description which mentions the country as well irrigated and supplied with canals and sluices.

Macedonian gold mines.—Philip king of Macedon, (Book 16th,) having taken Crenidas, and called it Philippi, so improved the gold mines in those parts, which before were but inconsiderable and obscure, that by building of houses for the works, he advanced them to bring in a yearly revenue of above a thousand talents.

Alexander the Great.—The siege of Tyre by Alexander the Great recounted in the 16th Book, required the execution of works on a a very great scale. Alexander demolished Old Tyre, as it was then called, and with the stones carried by many thousands of men, raised a mole two hundred feet in breadth across the sea, which by the help of the inhabitants of the neighboring cities, who were impressed for the purpose, was speedily carried out a considerable way. This mole was afterwards injured by a violent storm, when Alexander caused it to be repaired with trees laden with earth, and so again brought it near the city. By this and many other operations he was able to take the city, after a gallant defence, in which the inhabitants displayed much ability.

In the memorandum books of Alexander examined after his death, (Book 18th,) were found heads of six colossal plans, among which were the following,—that a plain and easy road should be made straight along the sea coast of Africa to the Pillars of Hercules, that six magnificent temples should be built, and that arsenals and ports should be made in places convenient for the great navy he contemplated. These things, although highly approved by the Macedonians, yet because they seemed things beyond all measure impracticable, were desired to be laid aside.

Inundations.—During the Seleucian war, (Book 19th,) the Macedonians under Eumenes encamped on the banks of the Tigris, about three hundred furlongs from Babylon, Seleucus occupying the river with a flotilla of small vessels. The Seleucians having sailed to an old water course, cut down the banks at a part where it had been filled up from length of time, upon this the Macedonian camp was surrounded with water, and all the tract of ground overflowed, so that the army was in great danger of being utterly lost. At last removing a great part of his army in flat bottomed boats, he caused all the Macedonians to repass the river, and then for the purpose of recovering his carriages and baggage, by the direction of one of the native inhabitants, he set about cleansing such another like place, by which the water might be easily diverted, and the ground all round about drained dry. When Seleucus perceived this he granted a truce and the works were suspended.

In the same book is the account of the natural inundation, by which the city of Rhodes was so much injured. Rhodes being built in the form of a theatre, and the rain very heavy, the water ran for the most part into one place, and the lower parts of the city were presently filled with water, for the winter being looked upon as over, no care had been taken to cleanse the channels and sewers, and the pipes likewise in the walls were choked up, so that the water stood several feet deep, until part of the city wall breaking down, the pressure was suddenly relieved.

Pilework.—In a mention of the Cimmerian Bosphorus in Book 20th, it is related that the king's palace was surrounded with the river Thasis, and that there was a road to it through the fens, guarded with forts and towers of timber, raised upon pillars over the water.

Demetrius Poliorcetes.—We find in the 20th Book, a long account of the siege of Rhodes by the celebrated Demetrius, who among other works made extensive mines under the city walls, which being told to the Rhodians by a deserter, the Rhodians made a deep trench along the walls, which was now ready to be tumbled down, and forthwith fell to countermining, and at length met the enemy under ground, and so prevented the mine from proceeding any further.

EXTRACTS FROM THE REPORT OF THE SECRETARY OF THE NAVY.

NAVY DEPARTMENT, *December* 4, 1841.

The steamships Missouri and Mississippi, built under the act of 3d March, 1839, the former at New York, and the latter at Philadelphia, are nearly ready for service, and will form a part of the home squadron.

Orders have been given for the construction of three steamers of medium size, under the act of 3d March, 1841, one at New York, one at Philadelphia, and one at Norfolk. In addition to these, Captain R. F. Stockton is superintending the construction, at Philadelphia, of a steamer of 600 tons, to be propelled by E.iccson's propeller; and Lieutenant W. W. Hunter is engaged in like manner at Norfolk with one of 300 tons, to be propelled by submerged water-wheels invented by himself. Very valuable results are anticipated from these experiments.

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Experiments in gunnery and projectiles, which have been conducted for several successive seasons, under the direction of Captain M. C. Perry, in the vicinity of New York, have been continued on board the United States steamer Fulton, Captain John T. Newton, but under the general control of Captain Perry. In testing a gun in the usual mode, it unfortunately burst, killing several men and wounding others. I have caused the subject to be investigated by a court of inquiry, whose finding shows that, however distressing and deplorable the accident may have been, no just censure can be attached to the officers conducting the experiment.

Measures have been adopted, and are now in process of execution, for supplying the navy with the requisite guns. Less progress has been made than was desirable, because of the great pains which have been taken to obtain the *best* guns which could be procured in the country. In a short time they will be furnished of the various descriptions used in the service, including Paixhan guns.

Under the appropriation of the last session, for the purpose of "making experiments to test the value of improvements in the construction of steamers and other vessels of war, and *in other matters connected with the naval service and the national defence,*" nothing has as yet been actually paid. Some experiments, however, have already been authorized, and others are now under the consideration of the Department, from which very beneficial results are confidently anticipated. It is not proper, however, to make them public at this time. So many scientific and practical men throughout the country are now turning their attention to the subject that we may reasonably expect great advantages from a judicious use of this appropriation.

I have, under your directions, taken measures for the construction of a steamer on Lake Erie, in compliance with the act of 9th September, 1841.

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Heretofore we have found in the shallowness of many of our waters, security to a certain extent, against invasion by sea. So long as maritime wars were conducted in vessels of large size and great draught, we had little to apprehend from them except at a few points, and those were susceptible of adequate defence on land. But this security can no longer be relied on. The application of steam power to vessels of war, and the improvements which have recently been made in artillery are destined to change the whole system of maritime war. Steamboats of light draught, and which may be easily transported across the ocean in vessels of a larger class, may invade us at almost any point of our extended coast, may penetrate the interior through our shallow rivers, and thus expose half our country to hostile attacks. The celerity with which these movements could be made, the facility with which such vessels could escape, and the promptness with which they could change the point of attack, would enable an enemy, with a comparatively inconsiderable force, to harrass our whole seaboard, and to carry all the horrors of war into the securest retreats of our people. The effect of these incursions would be terrible every where, but in the southern portion of our country, they might, and probably would be, disastrous in the extreme.

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Of what description of vessels our navy ought to be composed, is a question of great importance, and one which we are compelled to decide with reference to the practice of other countries. Doubtless a very large part of it ought to consist of steamships. Experience has shown that these vessels may be rendered perfectly safe at sea, and that they may be so constructed as to adapt them, in other respects, to purposes of war. Of their great usefulness the world has had a striking proof in the recent operations of the British squadron on the coast of Syria—troops were transported a distance of two thousand miles over the ocean, and were engaged in battle in Asia Minor on the sixteenth day after leaving England. This and other facilities afforded by this class of vessels were so great and effective that the admiral declared that "his success was owing to the efficiency of his steamers." We may well profit by the lesson thus taught us. I respectfully suggest, however, that it would not be wise in us to engage very extensively in the construction of steam ships of war of the largest class at this time. Imitating the example of England, our wisest policy would be to aid the private enterprise of our citizens in constructing packet ships, to ply between this country and foreign ports. These should, of course, be so constructed as to fit them for war purposes, and should be held subject to the demand of the Government upon equitable conditions. There will, in all probability, be enough of such vessels to answer all the purposes for which steam ships of the largest class would be furnished at a comparatively small cost to the Government. Improvements are daily made, not only in steam machinery, but in the propelling power applied to steam vessels. Experiments are now in progress which promise important results in these respects, and it would probably be judicious not to expend large sums in the construction of steam ships for distant cruises until these results shall be made known. But the same reasoning does not apply to steam vessels of a smaller class, destined for the defence of our own coast and harbors. These ought not under any circumstances, to be delayed. They would be particularly useful on the lakes and in the Gulf of Mexico. On the lakes they might be advantageously employed, under proper regulations, in the revenue service. They would be peculiarly adapted to the Gulf of Mexico, in consequence of the calms and currents which prevail there, and of their greater facility in making harbor in the violent tempests which are common in that latitude. There is, in truth, but the single harbor of Pensacola in which a ship of large draught can find shelter, although there are many which afford sufficient depth of water for steam vessels of the proper size. These vessels should be built of white oak, reserving the live oak for those of a different class.

Steamships have been built in Europe altogether of iron. As far as the experiment has been made, it is understood to have been successful. I recommend that it be made here also, with at least one vessel of medium size, sufficiently large to afford a fair test, without exposing too much to the hazard of failure. The great abundance of that material found in all parts of our country, affords us every facility which can be desired; and our workman will soon acquire if they do not now possess, the requisite skill in converting it into vessels. We may thus acquire a cheap and almost imperishable naval force, while, at the same time, we afford encouragement to some of the most useful branches of our home industry.

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The propriety of establishing naval schools has frequently been submitted to the consideration of Congress. I again respectfully bring it to your notice, as a subject of increasing interest to the navy. The use of steam vessels in war will render necessary a different order of scientific knowledge from that which has heretofore been required. If our navy should be increased by the addition of any considerable number of steam vessels, engineers will form an important class of naval officers. It will be necessary to assign to them an appropriate rank, and to subject them to all the laws of the service. Great care should be used in the selection of them, because a great deal will depend on their skill and competency; hence it is necessary that they should pass through a prescribed course of instruction, and that the Government should have the proof of their competency which an examination, conducted under their own rules would afford. This important object can be best attained by the establishment of naval schools provided with all necessary means of uniting practice with theory. The advantages which the army has derived from the academy at West Point afford a sufficient proof that a similar institution for the navy would produce like results.

In connection with this subject, I would ask your attention to the situation of the professors of mathematics now employed in the service. This useful class of men have no permanent connection with the navy, but are called in only as their services are needed, and are not paid except when on actual duty. The consequence is, that they cannot rely on this employment for support, and are often reluctantly driven to other pursuits. It is to be presumed that men whose talents and attainments qualify them to be teachers in the navy, are equally qualified to be teachers on land; and, and, as this latter is the less precarious position, the *best* qualified will be the most apt to seek it. Hence the Department cannot rely with any assurance on being able to command suitable professors at all times when their services may be required. It is, I think of great importance that some provision should be made upon this subject. I also recommend that a certain rank or position be given to the professors, which will relieve them from the necessity of messing and sleeping with the pupils. This close and constant association is well calculated to weaken the respect and influence which their relation to the young officers ought to inspire, and which is absolutely necessary to give due effect to their instructions. I doubt whether their services upon the present system are worth the money they cost, although they would be highly valuable under proper regulations.

[From the Boston Miscellany of Literature and Fashion.]

GREENOUGH'S STATUE OF WASHINGTON. *By* HON. EDWARD EVERETT.

This statue is a seated figure of heroic, or rather colossal size, being twice the dimensions of life. Were it erect, it would consequenty stand about twelve feet high. It represents the great hero, statesman and citizen with the right hand pointed to Heaven, and the left hand holding a sword, with the handle turned from the person. The upper part of the figure is bare; from the middle of the body down it is covered with a senatorial drapery. A very pleasing effect is produced by the manner in which the back of the chair is carved in open work, so as to display the back of the figure. The sides of the chair are wrought in low reliefs, symbolical of the character and fortunes of North and South America; and on the top of the chair, right and left, are figures of Columbus and of a native of our continent. The face is composed from that of Houdon, with a judicious comparison of the other contemporary authorities. It represents all the elevation, benignity and force of Washington's character—his firmness, tempered with pure benevolence; and it possesses an advantage not shared in an equal degree by that of Chantrey, and still less by that of Canova, in faithfully reproducing the well known features, with which every American claims a personal acquaintance, as of a familiar friend or venerated parent. It will be seen, however, that Mr. Greenough has by no means slavishly copied Houdon. * * * * *

This grand work is of one single piece of marble, not of pure white, which it is impossible to procure in masses of sufficient size for such a statue without stains fatal to its beauty, but of a bluish tinge highly favorable to the effect of a work of art. The marbles of this kind are now preferred for works of this description.

There are two points, in reference to which, we have heard Mr. Greenough's Washington criticised, and on which we beg leave to state our impressions. One is the absence of drapery from the upper part of the figure; the other is the precise significance or meaning of the statue, and the propriety of a sitting posture.

The first topic, that of the costume of works of art, is, of course, too extensive to be exhausted on an occasion like this. It presents, undoubtedly, some difficulties. There are two schools among artists in this respect, and two opinions among judges of art. Without engaging in the discussions, we may with safety say, that to confine the sculptor, in a great monumental work like the statue of Washington, to the exact imitation of the clothes and the manner in which the hair was dressed, is greatly to limit the field in which the creative skill of the artist is to be exercised, and to reduce to a low point the standard of the art. It rests upon the false assumption that the closest possible imitation of life is the object of the art of sculpture. It leaves little but the face which would not be purely mechanical imitation, and, not only so, but the imitation of the most grotesque and fantastical of human inventions. The caprice of man has certainly never wandered so far into the tasteless and extravagant, as in the department of the tailor and hair dresser. With all due respect even for these personages, as they existed and flourished in revolutionary times, we must boldly say, that there are few things more ungainly than the powder and pomatum, the ear-locks and clubbed hair, the coat and small-clothes of a continental major general of that period. If it were deemed desirable to perpetuate them, and if the imitation of nature were, without qualification, the principle of the art, it would be better, as they do in the wax-work museums, instead of torturing the marble, to put a *bona fide* peruke and a cloth uniform, faithfully fashioned after the moddel of 1776, upon the head and shoulders of the statue.

Mr. Chantrey, who belongs to what the English consider the school of historical imitation, in the matter of costume, has given Washington a drapery destitute of the only merit *such* drapery can have, that of resemblance to the costume of the time. Canova gave to Washington the Roman military costume, bearing no resemblance to the modern, covering the upper part of the person, but leaving a portion of the leg bare, conforming to ancient usage in military statues, but as unlike as possible to any dress actually worn in America and Europe in modern times. Mr. Greenough has adopted a drapery which meets all the requirements of delicacy, which is sanctioned by the authority of the greatest masters of art in ancient and modern times, and to which the public is now reconciled and familiarized in busts, which are almost invariably made either wholly nude, or with an artistical drapery unlike any thing actually worn. This drapery in the statue of Washington gives the artist the opportunity of displaying the nervous arm, the broad shoulders, the full throat, the arching breast and swelling muscles of an heroic figure, in all their beautiful and manly proportions and symmetry. That some objections to this mode of representing Washington will be felt by those who have not reflected much on the subject, nor traced the necessary details and consequences of any other system, we the less doubt, as we have already heard them made, and have at a former period felt them ourselves. We have, however, a confidence, founded on experience, that the more the subject is weighed the more these objections will be found to loose their force; and we are strongly inclined to the opinion that the public taste will finally settle down in the conclusion that Mr. Greenough has, in this respect, adopted the plan most consistent with the dignity of the work to be performed, and most likely to afford a refined pleasure, independent of the caprices of fashon, in all future time; for the period can never arrive, so long as there is any taste or fondness for the beautiful creations of art, when the skilful delineation and idealization of "the human *form* divine" will not be considered one of the highest efforts of imitative skill.

The other point on which we presume Mr. Greenough's statue will be criticised, because we know it has been, regards the congruity of a sitting posture, with the action *supposed* to be indicated; that is, the resignation of Washington's command at the close of the war. We emphasize the word supposed, inasmuch as this idea, however current and even natural on a hasty inspection of this work, is wholly groundless. That a military officer would not perform the act of resigning his command in a sitting posture, is so exceedingly obvious that it could not have escaped an intelligent artist. Common politeness requires the performance of every such act in a standing posture. Again, in point of fact, Washington resigned not his sword, but his commission. It is not to be supposed that an artist undertaking to record a specific event, would have wandered so far from the well-known historical truth as to substitute a sword for a roll of parchment. The object of the work is misapprehended when it is supposed to record the performance of any specific deed. It is designed to represent a character, not an action. It is Washington in the aggregate of his qualities, not Washington performing a particular exploit, or discharging any particular function or duty. It is the Washington of a whole life, not of any one moment. It is expressive and suggestive, not historical and descriptive. With such a significance, a seated posture is not only appropriate, but it is preferable to a standing one. There are very few *actions* that can be performed by a public personage sitting in a chair. Canova has selected one of the few for his Washington, but the congruity of the action with the military harness in which it is performed is questionable. But this posture is most in keeping with the repose and calmness personified in the character of Washington. The uplifted right hand, pointed to Heaven, does not perpetuate the memory of any gesture made by Washington, on any particular occasion; but it is in this way that the voiceless marble speaks out that habitual reliance on Providence which was so substantial an element of the character of the man. In like manner, the sword, in the other hand, is there, not as a weapon, but as a symbol. It indicates the military leader; but it is neither presented nor wielded. Washington is neither going to the field nor resigning, his command. He holds the sword which belongs to him as the commander-in-chief of the American armies. It is not taken in hand for use, although it is so held that it can be easily turned and grasped if occasion requires. It is not offered to be resigned, although it might, perhaps, without over-refinement, be inferred, from the peculiar manner in which it is held, that its owner is prepared and inclined to lay it down whenever it can be done with safety to the country. This explanation of the statute, it may be proper to say, is not given on the authority of Mr. Greenough. The writer of this article has never conferred with him on this point. It is the view of the matter which has spontaneously presented itself to his mind, for which the artist is in no degree responsible.

We will add but a single reflection on the subject, and it is this; that there is no one, in our judgement, however vivid his previous impressions, however exalted his conceptions of the character of Washington, that will not derive new views of its harmony, dignity, and elevation from the survey of this noble work.

DR. FRANKLIN'S OLD PRESS.

We are indebted to the kindness of Mr. J. B. Murray, of Liverpool, for a copy of the Liverpool Standard, containing the following account of Franklin's Printing Press. Mr. Murray has also sent us a copy of Dr. Franklin's Poem on Paper, printed at the identical press. It is a fine specimen of typography, and shows that the old machine is not yet superannuated by a great deal.

"*The Franklin Printing Press.*—The original printing press at which Dr. Franklin worked in London, as a journeyman printer, in the year 1725, '26, known as the 'Frankling Press,' arrived in this town a few days ago, prior to its departure for Philadelphia, where it will be placed in the Hall of the Philosophic Society, to which institution it is to be presented by Mr. John B. Murray, of New York. Mr. Murray has very considerately determined upon allowing this interesting memorial to remain in Liverpool till the end of the present week, and it may be viewed gratuitously at the Medical Institution, Mount Pleasant. The press is a strong, heavy and cumbrous piece of machinery, of ancient and primitive construction. In one of the beams is inserted a large brass plate, bearing the following inscription: 'Dr. Franklin's remarks relative to this press, made when he came to England as agent of Massachusetts, in the year 1768. The Dr. at this time visited the printing office of Mr. Watt's, of Wild street, Lincoln's-inn-fields, and going up to this particular press (afterwards in possession of Messrs Cox & Son, of Great Queen street, of whom it was purchased) thus addressed the men who were working it—'Come my friends, we will drink together: it is now forty years since I worked like you as a journeyman printer.' The Dr. sent for a gallon of porter, and he drank with them 'success to printing.' From this time it will appear that it is 108 years since Dr. Franklin worked at this identical press.—June, 1833.' The Dr. it appears, has changed his tactics in the period that had elapsed since he was journeyman. In his days of adolescence we learn he used to take his penny loaf and his gill of water, inculcating on his fellow workmen the virtues of tetotalism, by preaching of the ill effects of porter, and endeavoring to convince his hearers that there was more nutriment in the bread and water, than in half a pint of malt liquor. As agent for Massachusetts, we find him sending for a whole gallon of porter. On another brass plate is the following:—'Presented by Messrs. Harrild & Sons, printers' brokers, London, to the Franklin Library, Philadelphia, through J. B. Murray, Esq., October, 1841.' This interesting relic has been visited by some of the most distinguished of our townsmen; among them, many gentlemen of the medical, clerical and legal professions, with a large number of ladies, all of whom have expressed their great gratification at seeing it. At the suggestion of the Rev. Dr. Raffles, the press is to be put in motion in order to show the manner in which its illustrious master formerly worked it, and Mr. Mitchell of the firm of Mitchell, Heaton & Mitchell, printers, will attend daily during the hours of exhibition, from 12 A. M. till 4 P. M., and on Saturday, until 9 P. M., to strike off copies of an extract from Dr. Franklin's life, which will be presented to visitors. The admission to see this 'antique,' although by ticket, is, as we have stated, entirely gratuitous. There is, however, a box placed near the press for the reception of contributions to the Printers' Pension Society, an institution well known to our readers as being every way charitable and highly deserving. We were yesterday favored with an impression of one of Dr. Franklin's poetical effusions, taken at this ancient press, and were surprised at the clean and perfect appearance it possesses."

IRON, LEAD AND COAL.

The amount of iron manufactured in the United States is estimated at $29,265,000; of which Pennsylvania produces about one-fourth, principally wrought in the vicinity of Lancaster.

In 1839 there were received at St. Louis, Mo., 375,000 pigs of lead or 25,875,000 lbs.; in 1840, 352,000 pigs or 24,288,000 lbs., which estimated at 3½ cents per pound give for the whole a value of over two millions seven hundred thousand dollars, for less than three years. Most of this goes to New Orleans, and is thence exported to the north or elsewhere.

The different coal regions of Pennsylvania, have yielded this season up to the close of navigation as follows: Schuylkill, 585,000, tons; Lehigh, 135,000; Lackawana, 185,000; Pinegrove, 25,000 Shamokin, 20,000; total 925,000 tons, for one season in one coal producing State. These facts are but specimens, which illustrate the great mineral wealth of our country, and what immense resources yet lie hidden beneath our feet. There is hardly a region in the world, more rich in native ores, than the United States; and if but half the labor and toil in digging for gold and silver had been expended in searching for the less dazzling, but more really valuable beds of iron, and lead, and coal, and marble, etc., etc., our internal resources would have been doubled, and our riches proportionably increased. It is from the teeming breasts of mother earth, that we derive our amplest wealth; our greatest comforts, our very sustenance as a nation. These are treasures of which no one can despoil us, as they depend not on foreign markets, rely on no tariff for protection, for our home consumption is not yet supplied, and the demand, is yearly increasing. A pound of iron can be made a hundred times more valuable than a pound of gold. Gold has an intrinsic value, ever the same. Iron by manufacture can be changed in worth from one cent to thousands of dollars; thus a pound of crude iron, costs one cent, and allowing one seventh for waste, contains 6000 grains. It is first made into steel, then into watch springs, each of which weighs only one tenth of a grain and sells for one and two dollars; which, at the rate of $60,000 to the 6000 grains, would afford a value of nearly $150,000. We ask for no Potosi or Golconda, so long as we have the coal and iron formations of the Alleghany, and the lead mines of Missouri. These will be to us silver and gold, and precious stones.—*Savannah Georgian.*

New Era in Lake Navigation.—Under this head the St. Catherines Journal of November 25th, notices the arrival of a new steam and sail vessel, built at Oswego, for Messrs Bronson and Crocker, enterprising forwarders of that town. She is called the Vandalia, and is commanded by Captain Hawkins. Burthen 141 tons, sloop-rigged, with cabins on deck—one very neatly fitted up for passengers, the other for the crew. Her principal novelty is the Ericcson propeller, the machinery of which lies in a very small compass, and weighs only from four to five tons. The screws or paddles on each side of the rudder are about five feet in diameter, and act on the principle of sculling. When the vessel is laden, these act wholly under water. Engine about fifteen horse power. The Journal says the Vandalia left Oswego, in very unfavorable weather, with a cargo of 130 tons of merchandize, for Hamilton and Niagara. Notwithstanding the violent head winds and unusual roughness of the lake, she pursued her course in good style, between four and five miles per hour, which speed increased to seven and eight as the gale lessened and her canvass was brought into use. She steers delightfully—the movement of the screws assisting, rather than retarding, the operation of the rudder. This point was satisfactorily ascertained in the circuitous route of the canal, from Port Dalhousie to St. Catharines, where we had a full opportunity of testing the merits of this ingenious and novel invention. She glided along without any perceptible motion of the water, so that not the least injury to the banks of the canal need be apprehended from the swell of water which arises from the paddles of an ordinary steamer. After passing one of the smallest locks on the canal, at this place, with ease, and staying an hour or two for the inspection of the inhabitants generally, she returned to Port Dalhousie on her route back to Oswego. We cordially wish her owners every success, and fully anticipate, now the experiment has been tried and so successfully answered their expectations, that next season we shall hail a large number of vessels constructed on the same principles.—*Cleveland Herald.*

Fungous Vegetation in Wine Cellars.—A very remarkable kind of fungous vegetation is known to make its appearance in wine cellars, the substance which supplies the growth being the vapor from the wine in the casks or bottles. If the cellar be airy and dry, the vapor escapes, and no fungous vegetation is manifested; but if it be somewhat damp, and secluded from air and light, the fungous growth becomes at once apparent. Round every cork a mould-like vegetation will exhibit itself, and the vapor from the cask rising to the vaulted roof will there afford nourishment to great festoons and waving banners of fungi. In the wine vaults of the London docks, this kind of vinous fungi hangs like dark woolly clouds from the roof, completely shrouding the brick arches from observation. On a small piece being torn off and applied to the flame of a candle, it burns like a piece of tinder. Should wine escape from a cask in a moist and ill-ventilated cellar, it will altogether resolve itself into fungi of a substantial kind. A circumstance of this nature once came under the notice of Sir Joseph Banks. Having a cask of wine rather too sweet for immediate use, he ordered that it should be placed in a cellar to ripen. At the end of three years he directed his butler to ascertain the state of the wine; when, on attempting to open the cellar door he could not effect it, in consequence of some powerful obstacle. The door was therefore cut down, when the cellar was found to be completely filled with a firm fungous vegetable production, so substantial as to require an axe for its removal. This appeared to have grown from, or to have been nourished by, the decomposed particles of wine; the cask being empty, and buoyed up to the ceiling, where it was supported by the surface of the fungus.—*English Paper.*

Calculating Machine.—For the last two years Dr. Roth, of Paris, has been engaged in the construction of arithmetical machines, and the success that has attended his efforts hitherto proves he has accomplished his scheme for performing automatically all the operations of arithmetic, from simple addition, subtraction, multiplication and division to vulgar and decimal fractions, involution, arithmetical and geometrical progression, and the construction of logarithms, with ten plans of decimals. The machine in its present state works addition, subtraction, multiplication, and both kinds of progression quite mechanically. In division alone, the attention is required to avoid passing over the cipher. The arithmetical progression is of vast importance, as it operates from one farthing to millions of pounds sterling. Mr. Wertheimber, the proprietor and patentee of this invention, has two descriptions of these machines—a larger one, which performs sums in addition, subtraction, multiplication, and division; and a smaller, which performs addition and subtraction only. These machines have been submitted to the inspection of several gentlemen eminent for their scientific attainments, of whom, particularly Mr. Babbage, have expressed the most unqualified admiration at their unparalleled ingenuity of construction. Mr. Wertheimber had the honor of an introduction to the royal presence, at Windsor Castle, on Wednesday, the 6th inst., when both Her Majesty and Prince Albert were graciously pleased to express their approbation of the machines, and to order two of each sort to be supplied for their use.—*London Times.*

Steam Safety-valve.—The public will be happy to learn that there has at length been invented a means by which steam engines will be shorn of all their terror. We refer to an invention of Capt. Thomas S. Easton of New Orleans, and now in Mobile, of a valve which he calls the *Flue Safety-valve.* We cannot at this moment give a description of this wonderful but simple contrivance, farther than to say that it is applied to the flue inside the boiler; that it opens and causes the steam to escape into the flue, the moment that the water becomes as low as the flue, or the moment that an unsafe pressure of steam is generated; thus preventing both a collapse and the bursting of the shell. And we hesitate not to say, with our present impressions, and they are corroborated by the unqualified, nay, enthusiastic approbation of our most experienced and scientific engineers, that a flue cannot collapse if supplied with one of these valves. Repeated experiments have been made, and the promptness with which the required result is exhibited is most gratifying. In a few days we shall, with the approbation of the inventor, present our readers with a more particular description.—*Mobile Chronicle.*

Railroads and Agriculture.—We have noticed a little item in one of the northern papers, which conclusively shows the effect of railroads in developing the agricultural resources of the districts through which they pass. In a single day on that part of the New York and Erie railroad, which is completed between Goshen and Piermont, there were forwarded to New York 58,410 lbs. of butter; 30,312 lbs. of pork; 954 lbs. of beef; 5,359 lbs. of poultry; 1,015 lbs. nuts; 900 lbs. of live stock, besides 1,500 lbs. of sundries, in all nearly 100,000 lbs. of produce from one district in one day. What was formerly many leagues distant, requiring several days journey, at much expense of time and money, and great personal inconvenience, is now brought in direct neighborhood with a market, and can meet its demands and be in turn greatly enriched by its proximity.

So in time it will be with our railroad. Our farmers and planters have not yet learned to avail themselves, as they should, of the agricultural advantages which it offers, by which, though a hundred miles distant, they are, by this speedy communication, brought within a few hours of a market, which is the principal seaport of the State.
—*Savannah Georgian.*

AMERICAN

RAILROAD JOURNAL,

AND

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[For the American Railroad Journal and Mechanic's Magazine.]

DELAWARE AND HUDSON CANAL COMPANY.

We have before us the reports of this company for the 1st March, 1840 and 1841, which we will endeavor to elucidate, particularly as its safety as an investment, and the security of its debt to the State of New York, have of late been much discussed, with considerable variance of opinion in regard thereto. It certainly has been made to present the anomaly of late, of being at a premium, while New York State stock, certainly as secure as the rock of Gibraltar, is at a considerable discount. The stock of this company having been hitherto viewed as so entirely speculative, it is but natural at this period of general distrust, to enquire if any thing has occurred to take from it that character.

Its property consists in coal lands, railroad, canal, and sundry apparatus, the whole of which is said to have cost up to this time, three millions of dollars, of which there is said to be of their own capital,

2,000,000 at 7 per cent interest is			$140,000
Borrowed money from the State of New York, due in 1848, - - -	$500,000		
Due in 1850, - - -	300,000		
	800,000		
Private loans, - - -	200,000		
		1,000,000	
On which the annual interest is - - - -			55,500
			$195,500

being the amount they must nett from their *coal speculation,* to get an ordinary return on their capital, added to the risk of which, is the ownership of a canal, and other means of getting their coal to market.

Passing over their early struggles, we will start from the last three years, when they commenced to do a business somewhat commensurate to their establishment, and in that period it has been gradually increasing: thus,

In 1839, their shipments of coal were				- -	122,300 tons.
In 1840,	do	do	do	- -	148,500 "
In 1841,	do	do	do	- -	190,000 "

In the two first years, their dividends were 7 per cent. per annum; and for the first half of the past year of 1841, they have announced one of 5 per cent., or 10 per cent. per annum.

What then is the evidence that these dividends have been really earned? The preliminary step to come at this, is to find what may be near the *first cost* of their coal placed in market. This must necessarily be of a sliding nature, owing to much of their establishment being a fixed expense—such as five stationary steam engines, cars, steamboats, office rent and salaries. As an average, however, the following statement will come as near to the truth as is practicable, where the actual wear and tear of successive years, is not strictly assessed on each, but is often heaped on the last.

Mining, transportation, repairs, over 16 miles of railway, with five stationary engines, say, per ton, - -	$1 50
Freight in 30 ton boats, 105 miles of canal, of 110 locks,	1 40
Toll to meet canal repairs and expenses, say $100,000 per annum; on a business of 190,000 tons, - - -	53
General charges, office rent, salaries, steamboats and barges between New York and Rondout, etc., on 190,000 tons,	27
Interest on loans $55,500 per annum on a business of 190,000 tons, - - - - - - -	30
Say average cost delivered at Rondout or New York, on present large trade, per ton, - - - - -	$4 00

There is no charge made above for mine rent of the coal dug from, and by which their mines are annually so much depreciated—worth at least 25 cents per ton—no allowance for bad debts, nor for waste, nor sinking fund, as in strictness there should be, but against the two first, there is the set off of the return freights and a surplus of interest averaging together say, $45,000, and the waste, etc., may be covered by their selling at the short ton of 2,000 lbs.

Taking their own statement of the 1st March, 1841, and starting with the balance then assumed to be in hand, we may come at some understanding of the result of their operations in the last three years, and which appears to be, that a combination of luck in this last, has enabled them not only to make good all their previous dividends, but also to have the appearance of being left with a large surplus: thus,

By balance on hand 1st March, 1841, including coal on hand, the whole assumed by their statement to be worth at that date - - - - - -	$211,233
By sales of all their coal for 1841, 190,000 tons, at an average of $6¼ per ton, at Rondout and New York	1,187,500
By canal tolls and interest, say - - - - -	43,267
	$1,442,000

To dividends of 1839 and 1840, 7 per cent. each, or 14 per cent. on $2,000,000 - - - -	$280,000
To cost of placing 190,000 tons of coal at Rondout and New York, including interest on loans, at an average of $4 per ton - - - - - -	760,000
To dividend of 1841 at 10 per cent.* - - -	200,000
To surplus, *supposing all their coal realized by the 1st of March*, 1842 - - - - - -	202,000
	$1,442,000

The present year has been one of real harvest to this company. The foreign supply of coal has fallen off nearly one half, and but little of the old stock of anthracite remained at the opening of the season—while it was then enabled to begin operations without having received any material injury from the freshet of the 8th of January, 1841, which disabled its rivals, the Schuylkill for 2 months and the Lehigh canal for 5 months of the usual shipping season of 8 months; prices, therefore, although fluctuating during the year, have ruled higher than the last, and the average allowed to this company

* Then comes the question as to what is, at any given time, really left to divide as actual profit, the current expenses being understood to include the whole expenditure in every shape, and not merely the expenses paid, and which alone it was possible to have paid, but there should be ample security, that what appears in the account as nett profit, really is such, and that the future proprietors are not left responsible for any portion of the expenditure which has in fact been incurred and exhausted in earning the present apparent dividend. The object should be to avoid heaping an unusually larger expenditure on particular periods for wear and tear, which has been going on gradually during a whole series of years. A per centage as sinking fund should be set aside for this purpose, the amount of which will vary on different lines, according to the degree of excellence in the original construction of the work and stock, and to the *efficiency of the servants and establishments* of each company.—*English Railway Magazine.*

in the above account, for their sales between New York and Rondout, is a full one. The present rate of Peach Orchard is \$9, for Lehigh \$8½, for Schuylkill white ash, \$8, and Lackawanna \$7 per ton—all in retail from the yards, or ¾ to \$1 per ton less if sold afloat; and this latter coal—not generally so well liked as the other white ash coals—sells freely, however, at a dollar under them. It is said to be a great favorite with steamboats and the distillers, and has perhaps an advantage in being delivered more directly in market from the mines, without being subject to as many intermediate profits and charges which increases the cost of much of that from the Schuylkill and Lehigh regions.

To all outward appearance this company is managed with great economy in all its details, and were the present state of things to remain undisturbed,—that is, were it never to be possible to get anthracite coal to market other than by canals, then this coal speculation of the Delaware and Hudson canal company would seem sure to pay a fair return, and with the natural increase in the trade, might become very profitable.

What then can be said on the other hand, that is likely to subtract from so fair a prospect. It may be supposed that we all do, or should know, that the Philadelphia and Pottsville railway will be completed in a very few days, and although it may be difficult of belief to those interested in canals, it has really come to pass in the progress of the arts, that railways, as now constructed, can generally carry cheaper than canals, but particularly so in this case, as may be thus familiarly illustrated:

On the *Schuylkill canal*, 6 boats each of 54 tons, can deliver, on an average, in 10 days, 324 tons of coal in all, at a cost to each boat of \$45, (except a charge for renewal of boat,) or together \$270, being, as freight, per ton, - - 83 cents.

On the *Pottsville railway*, 1 locomotive and train of 50 cars can make five trips in 10 days, and deliver 200 tons each trip, or 1,000 tons in all, at an expense of \$85 per trip, or \$425 together, being per ton, - - - - 42½ cents.

The cost of freight on the canal, is, therefore, double that on the railway, and together with other economies possessed by the latter, it is enabled to advertise that it will deliver coal in market at \$1½ for the winter, \$1¾ for the spring, and \$2 per ton for the summer. Experience on other roads also teaches us that if these rates do not bring the trade, lower rates will be submitted to, the certain effect of which will be to force down the high toll and freights hitherto maintained on the other canals, and which have only operated as a bounty on the coal by the Delaware and Hudson. The Lehigh also hopes in the coming season to obtain an outlet at Blacks Eddy into the feeder of the

Delaware and Raritan canal, which will help to reduce its present cost of transportation—it may therefore be expected that the competition of the railway, as a cheaper carrier in the coal trade, will create the liveliest competition in it, and that prices will be brought down to the very lowest, at which they can be afforded, say $4½ to $5 per ton afloat; so that if the Lackawanna is to sell at 75c. to $1 per ton, as heretofore, under those rates, it is evident their speculation will be rendered very hazardous, neither can any thing be gained by curtailing it—the per ton cost, would only be increased thereby—onward is their only alternative, as it must also be with the other regions. It is, however, perceptible enough, that if they can maintain their business at 200,000 tons per annum, (and some are sanguine enough to think it practicable, by the increased consumption from low prices and spite the numerous avenues) that at $4½ per ton, they can divide 5 per cent. per annum on their capital of $2,000,000, and at $3 80 to $4 per ton the loan holders would be secure of their interest. We shall indeed be agreeably surprised ever to see it below this last price, and the public should be satisfied to get their fuel at even $4½ to $5 per ton, but that it should be cut down from 7 and $9 per ton, was in all humanity called for; and as the *only means* of attaining this truly charitable result, must they return thanks to the railway.

Although at present, rather a remote contingency, yet it is not altogether to be overlooked in scanning the future prospects of this company, in how much the Erie railway, which is to be located on the line of the Delaware and Hudson canal, will take from its back freights, and also what competition may come from the owners of the other coal lands in the Lackawanna region, who have proposed to connect with the Erie railway at a convenient point, which, via the Paterson railroad, would bring *their mines* within 140 miles of Jersey City, while those of the Delaware and Hudson, by railroad canal, and river, are 211 miles from New York. But this advantage in distance by the Erie railway route, is counteracted in part by its very high grades, and it will do well if it transports the coal as cheaply as by the canal route. Its main advantage will be in winter, and as being another scource of supply in emergencies.

We have thus endeavored to present impartially, whatever could be said for or against this concern, and we are free to confess it stands on firmer ground, than we, at one time, believed, which, as favoring the desirable object of cheapening fuel, while all interests are fairly served, is a pleasing persuasion to arrive at.

It would not fail to add to the confidence in this concern, could it find it to its interest to make its annual statements somewhat more businesslike and explicit.

And now for some of the latest statistics in the coal trade.

The consumption of anthracite coal in the last three years, has been in the following ratio:

1838 - - - - - - - - -	788,000 tons.
1839 - - - - - - - - -	867,000 "
1840 - - - - - - - - -	965,000 "

which includes the demand at tide water, as well as that on the line of the several canals, equal, in all, therefore, to 80,000 tons per month.

In the present year of 1841, there have reached *tide water* from the Schulkill region, per Philadelphia commercial list - - - - - -	557,000 tons.	
Lehigh (total shipped 142,000 tons) reached tide water - - - -	110,000 "	
Lackawanna (said to have reached Rondout) - - - - - -	190,000 "	
		857,000 tons.
Quantity left over 1st June, 1841, at which date supplies began to reach market - - - - - - - -		50,000 "
		907,000 "
Subject to 10 months consumption, *on tide water*, between 1st of June, 1841, and 1st of April, 1842, at, say 75,000 tons per month - - - - - - - -		750,000 "
Probable stock unconsumed 1st of April, 1842, if not absorbed by increased consumption - - - - - - - -		157,000

Thus may we at least be assured of an abundant supply until the opening of the ensuing season, about the middle of March next, when it were better not to be caught with much of the old stock on hand. The railway from the Schuylkill region will not probably be able to do much before that period, but, mean time, its effect is salutary in checking any further rise in price during the current winter.

The letter from Mr. Williams giving an account of the operations upon the Ohio railroad, will be found highly interesting. We should not omit to mention in this place, that the efficient action and arrangement of the machinery is due entirely to the ingenuity of Mr. Williams himself.

[To the Editors of the American Railroad Journal and Mechanics' Magazine.]

OHIO RAILROAD OFFICE, CLEVELAND, *December* 13, 1841.

You expressed a desire to be informed of our doings on the Ohio railroad, at as early a day as conveinent, and as the time has arrived when I have a few leisure moments, I hasten to inform you of the progress of our work. The two first divisions between the Maumee river and Lower Sandusky, thirty miles, is now completed ready for the iron. The third and fourth divisions between Lower Sandusky and Huron, thirty-three and one-fourth miles, will also be completed for the iron in March next. The fifth and sixth divisions, between Huron and Cleveland, forty-seven and one-half miles, is now under contract for the clearing and grubbing, and delivery of materials for the superstructure, to be completed in the spring. The company have now four steam piling machines and four locomotive portable saw mills at work, capable of completing five miles of road per month. The above is a summary statement of our work. I will also give you a brief outline of the railroads now in progress in our State, their connection with each other, and their contemplated connection with the roads in other States. First, we look to the New York and Erie railroad with much interest, and contemplate a connection (through Pennsylvania, forty miles) with our road, thereby giving us a direct communication with the city of New York, much nearer than by any other route, being less than five hundred and sixty miles from this city. The Little Miami railroad from the city of Cincinnati, and with the Mad river and Lake Erie railroad, connects with Lake Erie and with the Ohio railroad at Sundusky city, which with the Ohio railroad for a direct line from Cincinnati to the junction of our road, with Pennsylvania. The Mad river and Lake Erie company have their road completed to Tiffin, Seneca county, thirty-eight miles, and in operation with three locomotives. The Little Miami company have also some fifteen miles in operation and one locomotive. The Ohio railroad connects with the Maumee river, opposite Manhattan, at which point the Maumee branch railroad commences, and is to extend to Monroe, Michigan, eighteen miles, which is to be completed in 1842, and at Monroe it connects with the southern road of Michigan, thirty miles of which is completed, more in progress, and intended to extend to the head of Lake Michigan. Thus you will see that we are awake in the idea of a continued line of railroad from one end of the Union to the other, and when the link from the termination of the New York and Erie road to Buffalo, forty-five miles, shall be filled up, we shall be, as it were, near neighbors with Boston and New York. And I can but anticipate that all the roads here ennumerated will be in operation before the close of 1845.

Respectfully yours,

C. Williams.

[For the American Railroad Journal and Mechanics' Magazine.]

PENNSYLVANIA FINANCES.

We have been attracted by the following report, in anticipation, from the Treasurer of the State of Pensylvania, for the fiscal year, ending 30th of November, 1841, and which we have somewhat remodelled, that its principal points may be more clearly seen and understood.

Receipts.

Balance.		
From last year, 30th of November, 1840 - - - - - -	$625,200	
Debt due on Huntingdon breach and for uncurrent funds - -	350,500	
		$274,700
Public works.		
Received from canals - -	498,600	
Received from railways - -	556,800	
		1,055,400
Taxes.		
On bank dividends - - -	96,000	
Corporation stocks - - -	37,300	
Writs and certain offices - -	35,000	
Collateral inheritance - -	20,600	
Personal and real estate per act of 11th of June, 1840 - -	33,300	
	222,200	

Payments.

Public works.			
Paid for interest and other purposes thereon, total of		$2,844,000	
Deduct for interest on public debt - -	$1,600,000		
Applied towards finishing incomplete works -	800,000		
		2,400,000	
Leaving for repairs proper and salaries, etc. - - -		444,000	
Motive power on railways - -		292,000	
Repairs extra to Delaware division		68,000	
Loss by fire from locomotives -		7,800	
Westchester railway - -		5,000	
			816,800
Interest account.			
On debt for public works		1,600,000	
On debt other than public works		64,000	
			1,664,000

Auction and commission duties.		
Received on this account - -	89,600	
Licences.		
Taverns, retailers, hawkers and brokers - - - -	126,000	
Fees.		
Land and land offices - - -	24,000	
Dividends.		
From bank, turnpike, mining and bridge company's stocks -	148,400	
Petty receipts - - - - -	4,500	
		614,700
Loans.		
Various loans of 1840, '41, -	3,704,900	
Deduct paid off in 1841 -	674,900	
		3,030,000
Balance taken from receipts between 30th of November, 1841, and 1st February, 1842		145,600
		$5,120,400

Unfinished lines—expended thereon		800,000
Government expenses paid on this amount - - - -	306,000	
Militia expenses - - -	33,000	
Pensions and gratuities - -	49,400	
Colleges and common schools -	345,300	
Penitentiaries and institutions for the blind - - - -	49,400	
Geological survey - - -	12,700	
Premium on silk - - -	4,400	
Navigation, bridges and turnpike companies - - -	115,200	
Petty charges - - -	24,200	
		939,600
Interest account.		
Half yearly interest, due 1st of February, 1842, in specie funds - - -		900,000
		$5,120,400

Before remarking on the above statement, we may premise, that it has been the misfortune of Pennsylvania, that she has allowed her authorities to present their accounts studiously involved and obscure, and if this system of permitted concealment be allowed to continue, her present heavy load of debt can only grow the heavier. The detailed minutia furnished by the canal board of the State of New York, and the periodical investigations instituted by her legislature, through a select committee, into the actual condition of the public works, might well be recommended to her imitation.

So far as the above statement is to be relied upon as a guide, it presents the following features:

The receipts on her public works in 1841, were	1,055,400	
The disbursements for maintainance and repairs, etc. - - - - - - - - -	816,800	
		238,000

showing a surplus, but which it is quite probable outstanding and unsettled claims, would nearly absorb, and it will be well if we can feel assured, that the two ends now really meet.

The government expenses and other incidental payments, amount to - - - - - - -	939,600
The receipts from taxes and all other ordinary sources	614,700
Showing a deficiency on ordinary account of -	$324,900

This deficiency together with the interest on her debt up to the 1st February, 1842, will all have been met *principally by loans*, which also in that period, admitted of the appropriation of about $800,000, to her unfinished lines, such as the Wisconissco feeder, the north branch canal, etc.

The amount required to be raised before the 1st of February, 1843, in order to maintain her credit would then appear to be:

Interest due on public debt, a serious reality of, say	1,700,000
Deficiency on ordinary account and for contingencies, say - - - - - - - - - - -	500,000
	$2,200,000

and not allowing any appropriation to carry out unfinished lines, some of which, it is, however, of vital importance to complete, as now only making a total loss of the sums already expended on them.

In the present crisis of State credit, this sum can no longer be borrowed, at least out of her own borders, and can only otherwise come from the public works and taxation.

Of her public works, we can only say, that owing to the blended manner in which the accounts are given to the public, it has an impression, and seemingly a just one, that they are minus of themselves some $500,000 per annum, which, however, is belied by the above account, if it can be depended upon. There is undoubtedly something radically wrong in the management of these works—the *higher costs* of transportation by them for a shorter distance by one half, and the inefficient *state of the main stem* terminating at Cleveland, during the past season, caused much of the western trade to be diverted to the New York works, as their increase of tolls too well attest. Cannot *all this* be remedied for the future? Will it be in vain, now that this crisis has arrived in the affairs of this great State, that she has elected to her legislature a large *democratic majority*, whose business will be to see *the needful* carried out. The time has arrived when truth must be stared full in the face.

Of taxation:—the above account shows only the insignificant item from real and personal estate of $33,300, under the act of 11th of June, 1840, but it will be remembered that at the session of 1841, the acts regulating assessments on real estate were remodelled, by which the receipts were to be largely increased and other taxes were also laid, the effects of which have not yet appeared. The Harrisburg Intelligencer some time since furnished an able estimate of all the real estate, mineral and agricultural products of Pennsylvania, and which were made to amount to $1,460,000,000, presenting an abundant source, from which to derive all that was necessary. Could the Intelligencer point out a way by which this might be done, and help in some measure to allay the present anxiety, and to do away with the foolish notion that her public works, by which her other valuable means can only be properly developed, are to be given away, before it is seen that they cannot be made to work satisfactorily?

A writer in the United States Gazette of Philadelphia, anxious for the proper management of the Pennsylvania works, makes the remark, that "the cost of freight from Philadelphia to Pittsburgh will average the season round 100 per cent. more than from New York to Buffalo, besides being subject to two or more transhipments," and suggests as a remedy to this diversion of so much of the trade to the New York works,

1st. To reduce the tolls 33 per cent.

2d. To open the communication from Pittsburgh to the Ohio river, and there to unload from canal boats into the steamboats.

3d. Establish the lowest remunerating rates of freight, to be permanent throughout the season, and not slide from $2 50 early, down to $1 50 per 100 lbs, later in the season, 4th. Continue in one line from Philadelphia to Portsmouth, by way of Akron, on the Ohio canal, that *one receipt* may answer for the whole line, which would bring largely the produce of eastern Ohio, nearly all of which now goes to New York.

The present crisis admits of no more procrastination; on the dose to be now prescribed hangs the life or death of these only debilitated works; if of the right kind and *honestly* administered, recovery may, we think, be confidently hoped for. Let her best practitioners be summoned to the rescue. *The consequences to her creditors are too plain, if these assets are allowed to perish.*

State credit now presents the sorry spectacle of a battered ruin, of which, however, if Pennsylvania the keystone, gives way, not a vestige will be left. Such then is the responsibility which rests on her coming legislature.

[From the Journal of the Franklin Institute.]

PROGRESS OF PRACTICAL AND THEORETICAL MECHANICS AND CHEMISTRY.

Upon the Application and Use of Auxiliary Steam Power, for the purpose of shortening the time occupied by sailing ships upon distant voyages. By SAMUEL SEAWARD, *Member Inst. C. E.*

But few years have elapsed since the possibility of propelling vessels by the power of steam was treated as a chimera; and although the practicability of its application for short voyages has been successly demonstrated, by the numerous vessels plying between this country and the continent, it is but of very recent date that its employment for long sea voyages has been adopted. The weight of the powerful machinery and the fuel, and the consequent loss of space for cargo, together with many other circumstances attendant on the present construction of steam vessels, induced the author (who received the education of a seaman, and has since had extensive practice as an angineer,) to believe that a more efficient mode of employing steam power, for long sea voyages, might be adopted.

Notwithstanding the great improvements which have taken place in the construction of steam vessels, and their machinery, it would appear that the duration of the voyage ought not to exceed twenty days, after which time a fresh supply of fuel becomes necessary; hence, steam has rarely been adopted for very long voyages. The reason of this limit to the duration of the voyage of a steam vessel, as at present equipped, is that an increase of power does not produce a corresponding increase of speed, while the weight of machinery increases in proportion to the power employed, and in some cases exceeds it; for instance, small engines, with the water in the boilers generally weigh about one ton per horse power, while in some large engines the ratio is nearly twenty-five cwt. per horse power.

A quadruple increase of power will not produce double the original velocity in a steam ship, although in theory, such is assumed to be the case; for, as the weight is more than double, the immersed sectional area becomes greater, and a still further increase of power is necessary. It has been shown by experience, that if a vessel, with a given power, is propelled through the water at the rate of eight miles per hour, her speed cannot be doubled, even though the power be multiplied twelve times, and the entire hold of the vessel be occupied as an engine room.

The weight of fuel is also in direct proportion to the size of the engines; so that taking for example, two vessels of two hundred and of four hundred horse power respectively—that of the higher power will have to carry nearly double the weight, both of fuel and of engines, and it is still questionable whether the increased force will propel the one ship more than one and a half miles per hour faster than the other.

The space occupied by the engines and fuel, in the most valuable part of the ship, is also an important consideration: neither the "President" nor "British Queen" steamers, although of two thousand tons measurement, is capable of carrying more than five hundred tons of cargo, when the fuel is on board.

The author then examines the question of employing too much power in a steam vessel, and refers to the "Liverpool," as an instance that such may be the fact. It appears that with the original dimensions of thirty feet ten inches beam, and engine power of four hundred and fifty horses, being a proportion of power to tonnage of about one to two, and one-fourth the vessel was immersed four feet beyond the calculated water line, and a decided failure was the natural consequence; but when the breadth of beam was increased to thirty-seven feet, augmenting the capacity of four hundred tons, and giving the proportion of one horse power to three and three-fourths tons burthen, the performance of the engine and the speed of the vessel were both materially improved.

The "Gem," Gravesend steamer, one hundred and forty-five feet long, by nineteen feet beam, had two engines of fifty horse power each; the speed was insufficient, being only twelve and a half miles through the water; but when the same engines were placed in the "Ruby," which was one hundred and fifty feet long, and nineteen feet nine inches beam, the velocity of the latter vessel was thirteen and half miles per hour. A pair of engines, of forty-five horse power each, were then placed in the "Gem," without altering the vessel, and in consequence of the diminished weight and draught of water, her speed then nearly equalled that of the "Ruby."

The author does not condemn the application of considerable power for vessels, providing it can be employed without materially increasing the weight and the area of the immersed midship section. It appears that the length of a steam voyage, to be profitable, is at present limited to twenty days for the largest class of steamers; that we have about thirty others which can approach twelve days, while the majority cannot employ steam beyond eight days successively, without a fresh supply of fuel. It is evident, therefore, that more efficient means must be adopted for the general wants of commerce in our extended intercourse with the East and West Indies, the

Pacific, Mexico, Brazil, Australia, and all the distant colonies, which now demand rapid communication with England.

The author refers to a pamphlet, published by him in 1827, entitled "Observations on the possibility of successfully employing steam power in navigating ships between this country and the East Indies, by the Cape of Good Hope." He therein proposed that large square rigged ships, of fifteen hundred to eighteen hundred tons measurement, should be fully equipped and constructed so as to sail ten or eleven miles per hour with a fair wind; that they should carry engines of small power, to assist the sails in light winds,—propel them at a moderate speed during calms,—work into and out of harbor, etc.,—and thus shorten those portions of the voyages wherein so much time was usually lost.

To all well built good sailing vessels, of four hundred tons and upwards, "auxiliary steam" is applicable. A steam engine of the necessary power, can, without inconvenience, be placed in such vessels, either on or between decks, so as to propel a ship at the rate of four to five nautical miles per hour in a calm, and for this speed a proportion of one horse power to twenty five tons is amply sufficient. The practicability of applying this system to East Indiamen and other similar vessels, is then examined at length, and it is shown that the ordinary speed of these ships under sail, is before the wind, eleven to twelve miles per hour, and in a gale thirteen to fourteen miles per hour, which is greater by two or three miles per hour, than that of any ordinary steam vessel when under sail, on account of the latter being impeded by the wheels trailing in the water, and the slightness of their masts, spars and rigging. The auxiliary steam power might, therefore, be efficiently applied, either by using it alone, or in conjunction with the sails, so as to keep up a uniform speed, by which a great saving of time could be effected in a long voyage.

The conditions of sailing and steaming voyages to India, with the influence of the trade winds, are then examined, and the author proceeds to detail the experiments made by him, on board the "Vernon" Indiaman, which was the first sailing vessel that actually made a voyage out and home with "auxiliary steam."

The "Vernon," built in 1839, by the owner, Mr. Green, was one thousand tons burthen; the sailing speed was about twelve to thirteen miles per hour in a fresh gale, and being from her frigate build well calculated for the experiment, it was determined to equip her with a condensing engine of thirty horse power, placed midships on the main deck, between the fore and main hatchways; the space occupied being twenty-four feet long by ten wide. The weight of the machinery was twenty-five tons, and it was so arranged that the motion was communicated direct from the piston cross-head, by two side rods, to the crank on the paddle shaft, placed immediately behind the lower end of the steam cylinder, which was horizontal. The wheels were fourteen feet diameter, projecting five feet, and were so constructed that the float boards could be raised to suit the draught of water of the ship; or they could be taken entirely away, if necessary, leaving the shafts projecting only eighteen inches beyond the sides. Under ordinary circumstances they were disconnected from the engine by a simple contrivance, consisting of a movable head, attached to the crank on the paddle shaft, by turning which, one quarter of a circle, the crank pin was liberated, and the wheels turned freely round. The "Vernon," thus equipped, having on board nine hundred tons of cargo, and sixty tons of coal, drew seventeen feet of water. In the first trial, the speed of the vessel, under steam alone, was five and three quarters nautical miles per hour, demonstrating how small a power is necessary for a moderate speed. She then started for Calcutta, and though the piston rod broke three times during the voyage, owing to a defect in one of the paddle shaft bearings, the passage was satisfactory. The details are given minutely, as are also those of the homeward voyage which was performed from Calcutta to London in eighty-eight days, to which must be added seven days for necessary delay at the Cape, making a total of ninety-five days, which is the shortest passage on record. Great credit is given to Captain Denny for the judgment with which he used the auxiliary steam power, and the course taken by him, by which he was enabled to overcome the difficulties incidental to a first trial of so important a system. The success of the "Vernon," induced the immediate application of engine power to the "Earl Hardwick" Indiaman, and both these vessels are now on their voyage out to Calcutta.

For the purpose of demonstrating the ratio of power to velocity a table was also given, showing the velocities of ships of different tonnage, having steam power of various ratios, deduced from upwards of one hundred experiments on large steam vessels.

It was shown, that an engine of thirty horse power would propel a ship of twelve hundred tons burthen, at the rate of four knots per hour, while three hundred horse power would only propel the same ship at the rate of ten and five-ninths knots per hour. Hence, ten times the power would only prodnce about two and a half times the speed.

The principal points in the paper were more fully dwelt upon, and, in answer to questions from some of the members, Mr. Seaward remarked, that no steamer in England had ever been propelled at more than fifteen geographical miles per hour, through still water.

In some of the Government mail packets, the engines and coals were the full cargo of the vessel. The table did not apply to vessels overladen with power, for as the weight increased in the same ratio of the power, so the immersed sectional area was augmented, and the lines of the vessel, which might be well calculated for speed when at a proper draught, became lines of retardation, and the engines did not work up to their proper speed, owing to the depth to which the paddle floats were immersed. For instance:—The wheels of the "British Queen" have been plunged between six and seven feet, instead of four feet, which was the calculated dip; the engines at the same time diminishing their speed so much as to reduce the effective power from five hundred horses to nearly three hundred horses.

The only advantageous way in which great power could be applied, would be by contriving to prevent the increase in the weight of the machinery and fuel, and those engineers would be most successful who could so apply the materials of construction, as to ensure strength without the usual corresponding increase of weight.

Mr. George Mills, from his experience as a ship builder, at Glasgow, was enabled to confirm all that Mr. Seaward had advanced. On the Clyde, the employment of an excess of power in steam vessels had been carried to the greatest extent, without producing corresponding advantages either for speed, or in a commercial point of view. It would appear that the same error had, to a certain degree, been committed on the Thames, but less than on the Clyde; for on the latter river there were vessels with nearly double the power, in proportion to the size, as compared with any vessel on the former river. He believed that on the Thames no vessel had so much as one horse power for each register ton, whereas on the Clyde, there were steamers of seventy to eighty tons register, having single engines, with cylinders of fifty-four inches diameter which was more than one hundred horse power. It would appear that this application of extra power had only obtained a very moderate speed, while the great first outlay, with the commensurate current expenses, had reduced the commercial profit to the lowest point,—of this the proprietors alone could give any account; but as to the speed attained, he had seen three steamers of identical tonnage leave the Broomielaw at the same time, their engines being respectively of one hundred and ten, eighty, and sixty horse power; yet their speed was in the inverse ratio of their power: the vessel with the smallest engine arrived at Greenock first, the greater power second, and the greatest last. These remarks were only applicable to river boats. With regard to sea-going vessels, the system had not been carried to so serious an extent, yet with them the average proportion was about one horse power to two register tons, and some few reached as high as one horse to one and one-eighth of a ton.

As an example of an augmentation of power producing an opposite result from that which was intended, Mr. Mills mentioned two vessels called the "Tartar" and the "Rover," built by him and his (then) partner, Mr. Charles Wood. They were each of about two hundred and twenty tons register, built from the same draught, and in every respect as similar as possible, except that the engines, which were by the same maker, were respectively of one hundred and seventy and one hundred and thirty horse power; yet whenever they worked together, the one with the smaller power proved herself the faster vessel, either in a calm, with the wind, or even against it. The "Achilles," Liverpool steamer, which lately had an addition of thirty feet to her length, and eighteen inches to her breadth, augmenting the tonnage about one-fifth, had improved her speed upwards of one mile per hour, although she carried a much heavier cargo than before.

He had built a vessel of five hundred and sixty tons register, with engines of one hundred and thirty horse power on board—a proportion of power to tonnage of one to four; the stowage for cargo was ample; the accommodation for passengers excellent. She drew little water, and her speed was much greater than vessels of double her power. Yet in spite of all this, the vessel could not find a purchaser, because the power was not nominally large.

It would be asked—why, with these and so many similar instances, such a system was continued? It was not likely that the engineers would complain of having orders for large engines: and there were certain dimensions prescribed for the vessel, to which the ship-builder was under the necessity of conforming.

The chief cause of mischief, however, was the fiat of the public. It was believed that a great power would remedy want of speed and all other evils, and it was found indispensable for ensuring the confidence of travellers. Hence, the shipowners, who depend upon the public for support, were obliged, against the conviction of their experience, to keep up the errors occasioned by ignorance.

The president observed, that the condemnation of large power should not be carried too far, as experience alone had produced the increase of weight, strength and power, of the present engines, compared with those of the early steamers which were built, instancing the Halifax packets (Cunard's,) which with their great power in proportion to tonnage, had performed their duties satisfactorily.

Mr. Mills explained that the Halifax packets were built for the especial purpose of carrying the mails only, to perform the voyage in a given time,—about twelve days. The engines were built by Mr. Robert Napier, after the model of those of the "Great Western," which used their steam expansively; similar provisions had been made in the Halifax packets, but the expansion valves were seldom used.

Mr Field agreed with the principal part of Mr. Seaward's paper, but he would prevent an erroneous conception of the term *overpowering* a steamer. A vessel could not have too much power, provided that power could be advantageously applied, without causing too deep an immersion. A good result could be produced only by keeping a proper proportion between the machinery, the vessel, and the paddle wheels, and immersing the hull of the steamer only as deep as the true lines of draught.

Mr. Vignoles observed, that in this country the reputation of engineers depended upon the commercial success of the works they engaged in. An erroneous public opinion might have influence at present; but if the engineer and ship builder would determine to break these trammels, and produce such vessels as should force conviction upon the public mind by the speed attained, and show the proprietors the consequent commercial advantage, the present system would soon be abandoned.

Mr. Parkes eulogized Mr. Seawards candor in describing the errors in the first construction of the engine on board the Vernon; more was frequently to be learned from failures than from successful efforts, and no communications to the Institution would be so useful as those which gave accounts of defective design or construction, with the details of the methods adopted for remedying the defects. He directed attention to the performances of the "Great Western" steamship, which at least equalled those of the Halifax packets, without the disadvantages of being unable to carry cargo, or of shipping so much sea, when the weather was foul. The important feature of economy of fuel on board the "Great Western," might be in part attributed to the use of steam expansively. It was very desirable that the Institution should possess very full drawings and a description of the "Great Western," so as to be enabled to compare them with those of the Halifax packets, which had been promised by Mr. George Mills. He would impress upon manufacturers of marine engines the necessity of adopting a correct and uniform nomenclature of the power placed on board steam vessels. The nominal selling power did not accord with any calculation.

Mr. Field believed the table of velocities calculated by Mr. Seaward to be very nearly accurate. The speed of the "Great Western," when loaded to her proper draught, had been as high as 13 and 8 tenths miles through still water. There was an error in the alleged speed of Cunard's vessels; they reached Halifax in ten days, Boston in three more, and then had still one day's voyage to New York. The average duration of the voyages of the "Great Western," was about fourteen days and a half. If two hundred tons were deducted from the tonnage of the "Great Western" for cargo and the accommodation for the passengers, she would then be similar to the Halifax packets. The engines of the "Great Western" were nominally estimated at four hundred horse power, and the average consumption of fuel was twenty-six tons every twenty-four hours.

During the discussion, Mr. Cubitt had calculated the following-table, showing the rates of velocity which would be attained by substituting engine power, with its consequent weight of one ton per horse power, for cargo, so as to preserve the draught of water the same in all cases.

Mr. Seaward remarked, that his table of power and velocities was corroborated by Mr. Cubitt's—the practical results verified both. The great difference between the "Great Western" and the Halifax packets, consisted in the better adaptation of weight and power to tonnage, and the more economical consumption of fuel of the former over the latter—the one carrying cargo and passengers, the other only the engines and fuel, yet the "Great Western" travelled farther with the same quantity of fuel.

Table showing the power required to obtain various rates of speed in a steam vessel, where the total weight of cargo and engines remains in *all cases the same, and in which with a power of* 30 *horses, a speed of five miles per hour is obtained; and the total weight carried being in all cases* 1,000 *tons, and the engines weighing one ton per horse power.*

Weight of cargo.	Weight and power in tons and horse power.	Relative speed. (5 times the cube root of)	Speed in miles per hour.
970	30	1	5.
940	60	2	6.299
910	90	3	7.211
880	120	4	7.937
850	150	5	8.549
820	180	6	9.085
790	210	7	9.564
760	240	8	10.
730	270	9	10.4
700	300	10	10.772
670	330	11	11.119
640	360	12	11.487
610	390	13	11.756
580	420	14	12.050
550	450	15	12.331
520	480	16	12.599
490	510	17	12.856
460	540	18	13.103
430	570	19	13.34
400	600	20	13.572
370	630	21	13.794
340	660	22	14.01
310	690	23	14.219
280	720	24	14.422
250	750	25	14.62
220	780	26	14.812
190	810	27	15.
160	840	28	15.182
130	870	29	15.3615
100	900	30	15.535
70	930	31	15.706
40	960	32	15.854
10	990	33	16.037

[*London Journal of Arts and Sciences.*

The suggestions of Mr. Gillespie deserves attention. There is no greater cause of confusion than uncertain bearings, but even if the most accurate allowances for variation could be made, they would not be equal to a permanent line as established by monuments, either for accuracy or convenience.

[From the Northern Light.]

MAGNETIC VARIATION. *By* WILLIAM M. GILLESPIE, *Civil Engineer,*

The change in the variation of the magnetic needle now in progress, causes great embarrassment to country surveyors in their attempts to follow old lines; and the neglect of the due allowance produces frequent litigation among farmers, whose old boundaries are changed by every re-survey. Every reliable observation on this subject is therefore valuable; and the extensive circulation of the Northern Light in the interior of this State, makes it an appropriate receptacle for such data. The following observations were made during a recent survey of the enlarged Erie canal below Schenectady, and show the present bearings of three straight stretches of the canal, compared with the bearings of parallel ones observed in 1829, of as many line fences, and of the Upper Mohawk aqueduct. The number and length of the lines observed, preclude the influence of local attraction; the instrument employed has been carefully tested, and the only possible (though unlikely) source of error is in particles of iron existing in the plates of the compass used in 1829.

Objects observed.	Bearing in 1829.	Bearing in 1841.	Difference.
Straight line of 27 chains, -	S. $45\frac{1}{2}$° E.	S. 44° E.	1° 30′
Do do 20 do -	S. $44\frac{3}{4}$ E.	S. $43\frac{1}{4}$ E.	1 30
Do do 16 do -	S. 58 E.	S. $56\frac{3}{4}$ E.	1 15
Line fence, - - -	N. $31\frac{1}{2}$ E.	N. 33 E.	1 30
Do do - - - -	North.	N. $1\frac{3}{4}$ E.	1 45
Do do - - - -	S. $4\frac{1}{2}$ E.	S. 3 E.	1 15
Upper Mohawk aqueduct, -	N. 16 E.	N. $17\frac{3}{8}$ E.	1 $22\frac{1}{2}$
Average, - - - - - - - - - -			1° $26\frac{1}{14}$

The above observations show that in the last twelve years there has been an increase of about one and a half degrees in the westerly variation of the north end of the needle.

Suppose A B to be a line fence, the bearing of which in 1829 was N. $31\frac{1}{2}$° E., *i. e.* which then made an angle of $31\frac{1}{2}$° with N S, the magnetic meridian, or direction of the needle at that time. In 1841 the bearing of the same fence is found to be N. 33° E., an increase of 1° 30′. The fence has not moved, and therefore the change must be in the direction of the magnetic needle, the north end of which now points 1° 30′ west of its former direction.

The surveyor who wishes to run out an old line in this vicinity, should apply this correction, by *adding* it to the bearings which are north or east of north, and south or west of south; and by *subtracting* it from those which are east of south, or west of north.

When to this constantly increasing variation we add the diurnal and monthly changes of the needle, it will be at once seen how imperatively the security of land owners demands some simple and unchangeable standard. Comparatively few of those by whom the boundaries of farms are established, possess either the necessary education or instruments to enable them to determine correctly the true meridian; and the delay and expense incident to the operation must always prevent its general adoption. All the desired ends may, however, be obtained in the surest and simplest manner by a method suggested and developed by Mr. Roberts, late city surveyor of Troy. Meridian monuments should be placed in every town under the sanction of a general State law. By these the instruments used in in every survey should be required to be tested, and the variation recorded in the field-notes. When a re-survey is desired, the present bearing of these monuments (which is taken as easily as any other course) is compared with the recorded one, and the compass is adjusted by its nonius for the change. Even if the line of the monuments should not be perfectly correct, the permanence of its direction would be sufficient to show the relative change from year to year, and for this purpose it would be a surer guide than even the most accurate establishment of a meridian line; since it has been suggested with some plausibility, that the meridians may vary in consequence of a change in the position of the terrestrial poles. The subject is one well deserving legislative attention; but until some uniform standard is established, every observer should contribute his mite to the common stock of recorded facts.

SCHENECTADY, *November* 27, 1841.

EXTRACT FROM "A SKETCH OF A RAILWAY JUDICIOUSLY CONSTUCTED BETWEEN DESIRABLE POINTS."

The New Jersey railway, from Jersey City to New Brunswick, 34 miles, shows the advantage of way travel and low fares on a comparatively *dense population.* From its statement of 22d February, 1841, we extract as follows:

The cost of the road (including $353,000 for right of way,) and motive power, etc., $1,951,600. It has been in partial operation for some time, and was opened to the Philadelphia travel on 1st of January, 1839. The highest grade on it is twenty-six feet per mile.

Gross receipts in 1839 were	$233,700	Expenses in 1839,	$110,800
" " 1840 "	203,100	" 1840,	116,700
	$436,800		$227,500

Average of expenses on gross receipts equal to - 52 per ct.

Through passengers in 1840, at $1, -		79,300	Gross receipts $203,100.
Way passengers between Newark and New York, - - - -	215,700		
Way passengers between all other places, - - - - -	108,090	323,700	
Merchandize, tons, - - -		5,300	

The way travel amounted to nearly two-thirds of the gross receipts. Its influence on the meat market is most salutary—it has frequently delivered in one train from New Brunswick in two hours 50 to 60 head of cattle that are scarcely sensible of a change of place, while by boats they are worried out of at least 8 per cent. of their fat, and arrive otherwise unmarketable.

The first six months of 1841, shows a rapid increase of travel on this road, attributable, no doubt, to the great despatch and accommodation which is there found by the public. The low fares are here also very operative, and during the holiday week, embracing the 4th of July, near 10,000 people passed over the road at an average charge of only 30 cents per head. Prior to this convenience, its line was comparatively a desert. It is much to be regretted that it should be intercepted near midway between two such important terminations, and should be subject to the *disadvantages of a short line,* its present equipment for 34 miles, answering nearly for the whole distance to Philadelphia of 87 miles. With the practicability of getting through this distance in 4 hours easily, full in view, it is hard that people are obliged to be quiescent under the present 7 hour system.

It may, however, in the meantime, be confidently expected that the way travel will meet all the expenses of the road; and as they have now temporarily arranged with the Camden line, for a more equal participation in the *through travel,* this source will no doubt in future give fair dividends to the stockholders.

The falling off in receipts in 1840, was owing to interruptions occasioned by the burning of the long bridge over the Hackensack; this and some other disasters by freshets to the turnpike bridges which they have to maintain, obliged them to intermit the dividend at the beginning of 1841.

Some competition is still maintained by the steamboats to Newark and New Brunswick, charging to the latter place, 40 miles, 12½ cts., while by the railroad, 34 miles, at 75 cents, it gets the majority of the travel, and the boats scarcely maintain themselves. The road would have conceded to them the freight between these points, but disagreeing, they have now put on a line leaving Brunswick early in the morning, which brings the market truck to the city two or three hours before the boat, and enables them to return in the evening at 5 o'clock, the passage money being twenty-five cents for both ways.

The competition between a railway and a steamboat line is here found under so near a parity of circumstance as to make it a fair contest, and the result is decidedly in favor of the former, to which we may well refer in support of the ground taken by the projectors of the New York and Albany railway, and which we have detailed in note No. 30, as to their ability to contend successfully against steamboats on the Hudson river, so as at least to compel them into a rate that would be mutually advantageous, and at the same time be an accommodation to the public. The business will be quite ample for both on this constantly growing thoroughfare.

STATE WORKS OF INDIANA. *Extract from Governor Bigger's Message.*

In the year 1827, the State of Indiana obtained from the General Government a grant of land to aid in the construction of the Wabash and Erie canal, with a view to connect the Wabash river with Lake Erie. A portion of this grant was surrendered to the State of Ohio on the condition that she would construct the canal from the boundary of Indiana to the lake. This canal has been completed, ready for navigation, from Lafayette on the Wabash, to the eastern line of the State. This work is not generally regarded as forming a part of the general system of internal improvements, in the prosecution of which the State subsequently engaged in the year 1836. It is now understood that Ohio will complete her portion of the line in 1842; by which an uninterrupted communication will be opened between the Wabash and Lake Erie.

In the month of January, 1836, the Legislature passed an act to provide for a general system of internal improvements, embracing a number of expensive works. The extent and present condition of these works, including the Wabash and Erie canal, with the total disbursement thereon, up to the present time, with the expenditure under every head, may be briefly summed up as follows:

1. The Wabash and Erie canal from the State line to Tippecanoe, 129 and three-quarters miles in length, completed and navigable for the whole distance, at a total expenditure, including payments for every purpose, of $2,041,012. This sum includes the cost of the steamboat lock at the Delphi dam, now nearly finished.

2. The extension of the Wabash and Erie canal from the mouth of Tippecanoe to Terre Haute, 104 and one-half miles—total probable cost, $1,500,000—amount expended, $308,855. The navigation opened so far down as Lafayette, and a portion of the work performed in the vicinity of Covington.

3. The Crosscut canal from Terre Haute to Central canal, 49 miles in length; estimated cost, $718,672; amount expended, $420,679. No part of the work is navigable.

4. The White Water canal, from Lawrenceburg to the mouth of Nettle creek, 76 and one-half miles; total estimated cost, $1,675,738; amount expended, $1,099,867. Thirty-one miles of this work navigable, extending from the Ohio river to Brookville.

5. The Central canal, from the Wabash and Erie canal to Indianapolis, including the feeder dam to Muncietown; total distance, 124 and one-quarter miles; total estimated cost, $2,299,853; amount expended, $568,046. Eight miles completed, other portions nearly done.

6. Central canal, from Indianapolis to Evansville, on the Ohio river; length 194 miles; total estimated cost, $3,532,394; amount expended, $831,302; 19 miles of which at the southern end, connecting with the Ohio river, is finished, and 16 miles, extending south from Indianapolis, nearly finished.

7. Erie and Michigan canal, 182 and three-quarters miles; estimated cost, $2,624,823; amount expended, $156,324. No part of this work is finished.

8. The Madison and Indianapolis railroad, 85 and three-quarters miles long; total estimated cost, $2,046,600; amount expended, $1,493,013. Road finished and in operation for about 28 and one-quarter miles. Grading very nearly finished on 27 and one-quarter miles in addition, extending to Edinburgh.

9. Indianapolis and Lafayette turnpike road; 73 miles in length; total estimated cost, $593,737; amount expended, $72,182. The bridging and most of the grading done on 27 miles from Crawfordsville to Lafayette.

10. New Albany and Vincennes turnpike road, 105 miles long; estimated cost, $1,127,295; amount expended, $654,411. Forty-one miles graded and McAdamized, extending from New Albany to Paoli, and 27 miles in addition partly graded.

11. Jeffersonville and Crawfordsville road, 164 and three-quarters miles long; total estimated cost without metalling, $952,000; with metalling added, the cost would be $1,651,800; amount expended, $372,733; forty-five miles partly graded and bridged, extending from Jeffersonville to Salem, and from Greencastle north.

12. Improvement of the Wabash rapids, undertaken jointly by this State and Illinois; one-half of the estimated cost of which is $102,500; amount expended by Indiana, $9,539.

There has also been paid for the general contingent expenses of the Board of Internal Improvements, for the purchase of instruments, etc., chargeable alike to all the public works, the sum of $35,564 41.

By summing up the foregoing statement, it will be seen that the whole length is 1,289 miles, 281 miles of which have been completed; aggregate estimated cost of all the works, $19,914,424; amount expended for all purposes, up to this date, $8,164,528 21.

The above estimates of the cost of the entire lines are based on the cost of the work already, from which it appears it would require to complete the whole of the above works, $11,750,000. At the present reduced prices it might take less, were it not for the loss and dilapidation on the unfinished portions of the works.

LIBRARIES—PUBLIC AND PRIVATE.

By estimates based on the most authentic data, it appears that the aggregate number of books in all public libraries in the United States, barely exceeds numerically, the number contained in one European city, say Lyons; and that the whole, if brought within the compass of one library, would not greatly exceed one of the first-rate libraries of Europe. They also show, that all the books in all the public libraries of this country, form but about one-tenth of the number contained in the public libraries of Germany, and half the number in those of Paris. These are startling general facts, which should engage the attention of Congress when it becomes necessary again to devise means for getting rid of a surplus revenue. How absurd all the wrangling, a few years ago, on that subject, when the national library at Washington continued but twenty-five thousand volumes!

The largest library in Europe is *La Bibliotheque du Roi* at Paris, which contains 630,000 printed volumes, and about 80,000 manuscripts, besides more than two millions of medals, maps, engravings, and historical documents. The library in the Vatican, at Rome, is said to contain 400,000 printed volumes, and 50,000 manuscripts. There are large libraries in Naples, Florence and Milan. The Royal Library of Madrid, contains about 200,000 printed volumes, kept in the Escurial palace. The Royal Library of Munich, in Bavaria, the largest in Germany, contains 540,000 printed volumes and 16,000 manuscripts. The Imperial Library of Vienna, and the Royal Libraries of Berlin and Dresden, contain each nearly 300,000 volumes. The Universites of Gottingen, Breslau and Munich, have also large libraries. The Imperial Library of St. Petersburg contains 430,000 printed volumes, and 15,000 manuscripts, and the Royal Library, of Copenhagen contains a like number of manuscripts, and 410,000 printed volumes. The Bodleian Library, at Oxford, the largest in Great Britain, contains 420,000 printed volumes, and 30,000 manuscripts. The British Museum, in London, contains nearly 300,000 volumes, besides 22,000 manuscripts; and there are extensive libraries at Cambridge, Edinburgh, and Dublin.

Besides those mentioned above, there are in nearly all the cities and large towns of Europe libraries that surpass in extent and value the best in the United States. The largest collections of books in this country are the following:

	Vols.
Philadelphia, (including Loganian) - -	52,000
Harvard University - - - -	45,000
Boston Athenæum - - - -	32,000
New York Society - - - -	36,000
New York Mercantile - - - -	12,500
New York Apprentices - - -	12,000
New York Historical Society - - -	11,000
Library of Congress - - -	25,000
Charleston (S. C.) - - - -	16,000
Andover Theological Seminary - - -	14,000
American Antiquarian Society - - -	13,000
American Philosophical Society - - -	5,400

All the books in all the Universities and Colleges of the United States, amounting to one hundred, inclusive of the libraries belonging to the students, amount, as nearly as can be calculated, to 400,000 volumes. All those in the Theological Seminaries, 35 in number, amount to 100,000 volumes. All the books in all the other libraries in the principal cities amount to 250,000 volumes—presenting an aggregate of seven hundred and fifty thousand volumes. The aggregate of all the volumes in all the public libraries of Europe, is fourteen millions five hundred and twenty-seven thousand.

Besides the public libraries which we have mentioned, there are others of less importance in some of the larger towns; and there are many private collections which are comparatively more valuable, as they do not generally embrace duplicates, worthless books, etc., which swell the numbers of volumes in some of the public libraries. The libraries of E. D. Ingraham, Isaac R. Jackson, and Mr. Barton, of Philadelphia, each contained from 10,000 to 15,000 volumes, and there are several others which are extensive and curious, among which may be mentioned that of Mr. W. McCarty, which contains a very large number of valuable works relating to America. In New York, we believe, the largest private library is that of Clement C. Moore, (formerly one of the Professors of Columbia College) Samuel Ward, Professor Anthon, R. W. Griswold, Edwin Forrest, and many other gentlemen, have collections containing each from 5,000 to 12,000 volumes. In Boston, too, there are a large number of very excellent libraries belonging to individuals. Those of Professor Ticknor, Mr. Douce, Wm. H. Prescott and George Bancroft, are among the best. These gentlemen will pardon us, should they see this article, for alluding so particularly to the good example they have set to their fellows.

Good libraries, public and private, are increasing. The great Astor Library, in New York, will probably surpass every other in this country in the value of its books and the completeness of its collections in the various departments of science and polite letters. The Rev. Dr. Coggswell, to whom Mr. Astor has entrusted the business of purchasing, has already obtained many important works, and will continue, we understand, to enlarge the collection, as opportunities are presented, until the edifice for its reception is erected. This library, like those of Europe, will be *free;* open to any citizen or stranger of respectable manners and appearance. It is becoming fashionable, too, for all persons claiming to be gentlemen, to have books in their houses—good books, the possession of which shall evidence taste and judgment. Better times are dawning upon us.—*Philadelphia Gazette.*

The Baltimore Library contains about 14,000 volumes. Several of our citizens have very valuable private libraries, but of the precise number of volumes we are not informed—that of R. Gilmer, Esq., contains many rare and valuable books, with numerous autographs and isographs; the collection of autographs, we believe, is the largest in this country, with the exception of that of Dr. Sprague, of Albany.—*Baltimore paper.*

RECESSION OF NIAGARA FALLS.

The last number of the Hingham Patriot contains the following sketch of some of Mr Lyell's views, expressed before the Lowell Institute, on the subject of the Falls of Niagara:

"The lecture which Mr. Lyell gave last Saturday, contained some statements so very curious and interesting that I cannot forbear giving you a little account of them. His subject was the *Recession of Niagara Falls.* He presented to his audience a very beautiful bird's-eye view (somewhat resembling the style of theatre scenery) of the whole country from Lake Erie, and including a portion of that lake, to Lewistown and Queenstown, about half way between the Falls and Lake Ontario. The view was designed by Bakewell, son of the great English geologist, and painted by Russel Smith, of

Philadelphia, an artist whose skill is well known to all who have visited the theatres of that city. It gave a distinct view of the whole course of the Niagara river, from the lake as far down as those two towns, including, of course, the Falls. These towns—the latter on the Canada, the former on the American side of the river —are built just under a precipitous cliff, 370 feet high, the scenery about which is so beautiful and grand that the lecturer said it would be well worth the visiting, even if there were no falls near, and no other attraction. This cliff is seven miles from the Falls, and the learned lecturer supposes that its base, and the whole surrounding country below, was once severed by a vast inland sea, of which the present lakes are but small remains; that, after the removal of this sea, Niagara river poured over this cliff; that then the Falls were perhaps 200 feet higher than they now are, for there is now a gradual decent in the river of 100 feet between the present Falls and Queenstown; that the Falls have been gradually wearing away this cliff underneath the river, until it is now seven miles above where it used to be; that the Falls are receding and diminishing in height year by year, till in the course of time, should the world last long enough, there will be no Niagara Falls at all—they having backed quite into Lake Erie! In their place there will only be irregular rapids. He said there was certain and incontrovertible geological proof that they had reached three miles; and it was presumable, from the face of the country and its geological structure, that they had the whole seven. The settlement of that region has been so recent that of course history can shed but little light on the matter; yet even during the short period that has elapsed since the whole country was a wilderness of bears and savages, there is historical proof of great change. The first account of the Falls that ever appeared in print was written by a Jesuit, who visited them in 1678—one hundred and sixty-three years ago, and there was then, according to his description, and according to the engraving that accompanies it, another fall from west to east, in front of and across those now existing, formed by the westerly side of the river running against Table Rock. A considerable portion of the edge of this rock has since fallen away, and of course the extra cataract caused by it has gone. He said that persons living in that vicinity told him that they could perceive a recession of about one yard per year, those who have lived there fifty years said the Falls had receded fifty yards in that number of years. Mr. Lyell said that he visited that region in company with a distinguished geologist who had been there five years before, and who said he could perceive there had been a considerable change during that period. And who do you think that fellow-traveller was? James Hall, once a Hingham boy, now one of the first geologist in America. The Falls are now 160 feet high; 760 years hence, Mr. Lyell said, computing according to the past, they would be but 120 feet high; and he gave the date (I have forgotten how far forward in the regions of futurity it was) when they would be only 80 feet high—just half of their present height! He referred also to artificial causes, canals, mills, and factories, which are turning off the water of the lakes, and will help to diminish the grandeur of the Falls."

RETURNS OF BRITISH RAILROADS.

There have been constructed and brought into operation in Great Britain, from the year 1830 to December, 1840, upwards of 1100 miles of railroads, in which has been invested about £60,000,000 sterling, or $288,000,000. The lines have been much extended during the year 1841. On the chain of railroads connecting London with Birmingham, Liverpool, Manchester and Preston, which, with the branch to Aylesbury, (7½ miles) amounts to an aggregate length of about 260 miles, the total receipts for the year ending June 30, 1840, were £1,467,562. The expenses during the same period including interest on borrowed money, being £920,893; or nearly 56 per cent; making an average daily income of £49 20s. 14d. or £15 9s. 3d. (about $74,) per mile. The receipts on these railroads since that period have greatly increased, while the expenses have diminished.

The London Railway Magazine, of October 30, gives the returns for one week in October, of a number of railroads in Great Britain, and one in Ireland, from which we have prepared the following tables:

Name	Total weekly receipts.	Receipts per mile week.	Length per miles.
Birmingham and Derby, - -	£1,283	£29½	48
Birmingham and Gloucester, - -	1,862	38½	48¼
Chester and Birkenhead, - -	446	29¾	14½
Eastern Counties, - - -	824	47	17
Glasgow and Ayr, - - -	1,116	28	40½
Glasgow and Paisley, - - -	819	33¾	22
Grand Junction and branches, - -	9,049	76	119
Great North of England, - -	1,339	33½	44
Great Western, - - -	12,992	102½	117½
Hull and Selby, - - -	955	31	30¾
Lancaster and Preston, - - -	514	25¼	20½
Liverpool and Manchester, - -	4,685	151	31
London and Birmingham, - -	16,148	142¾	112½
Aylesbury branch, - - -			7½
London and Blackwell, - -	668	178⅛	3⅔
London and Brighton, - -	2,218	47¼	48
London and Croyden, - -	491	46¾	8¾
London and Greenwich, - -	779	208	3¾
London and South Western, - -	5,607	73¼	76¾
Manchester, Bolton, etc., - -	586	58¾	10
Manchester and Birmingham, - -	313	62½	49½
Manchester and Leeds, - - -	4,348	87	56
Midland Counties, - - -	2,658	46¾	57
Newcastle and Carlisle, - -	1,501	25	60
Northern and Eastern, - - -	890	34½	28¼
North Midland, - - -	4,331	59½	72¼
North Union, - - -	1,118	48	22½
Preston and Wyre, - - -	249	12¾	19½
Ulster, (Ireland.) - - -	203	25¼	8
York and North Midland, - -	1,655	72	23
Total receipts in one week,	£79,646		1,226

Equal to $382,300, averaging on the above 1,226 miles of railroad, $312 per mile. "About 40 per cent., or two-fifths of the receipts," says the London Railway Magazine, "may be accounted for wear and tear, and the rest is profit to pay interest of cost." The nett income of the above railroads during the week stated, after deducting 40 per cent., is about $187 per mile, or $229,380 on the 1,226 miles—equivalent to $11,927.760 per annum.

It is to be observed that several of the works in the above list are only in part opened, but the length of each railroad, as stated, is near the actual number of miles at present in operation.

The following are the returns of passengers conveyed in one week in October, on some of the above railroads:

	Per week.	Per day.
Chester and Birkenhead, - - -	5,356	765
Eastern Counties, - - -	25,192	2,170
Glasgow and Ayr, - - -	12,939	2,157
Glasgow and Paisley, - - -	11,961	1,993
Great Western, - - -	29,783	4,255
Hull and Selby, - - -	3,801	543
Lancaster and Preston, - - -	2,314	331
London and Blackwell, - - -	35,340	5,049
Do and Brighton, - - -	4,342	620
Do and Croyden, - - -	7,897	1,128
Do and Greenwich, - - -	25,617	3,660
Manchester and Birmingham, - -	10,820	1,546
Midland Counties, - - -	9,382	1,340
Northern and Eastern, - - -	9,557	1,365
North Union, - - -	3,936	562
Preston and Wyre, - - -	1,927	275
Ulster, (Belfast) - - -	7,288	1,041
York and North Midland, - - -	7,771	1,110
Total 536 miles, - - -	205,223	29,810
Average per mile, - - -	383	55

This number of passengers would be equal to 440 per day on 8 miles of the Harlem railroad, 4,290 on the Utica and Schenectady railroad, (78 miles.) or 24,750 on the New York and Erie railroad, (450 miles.)—*N. Y. Courier and Enquirier.*

New Machine for Breaking Hemp.—We are indebted to an observing friend, for the following account of a valuable improvement in the mode of breaking hemp. Its general adoption will prove a valuable aid in getting out this valuable staple of our State. —*Kentucky paper.*

"I made a visit to the country ten days since, to witness the operation of a *Hemp Breaking Machine*, recently erected on Mr. Breckenridge's farm on Beargrass, by Mr. Denseford, his ingenious overseer. I found the machine breaking, or crushing hemp, with a rapidity that more than supplied ten men who were at their breaks, with hemp, and enabled them to dress or clean about a double quantity. The machine is simple in its construction and operation, and is propelled by horse power. A single horse is sufficient.

"Two fluted cylinders are placed horizontally in a frame, so as when in motion, to draw the hemp between them, and so crushing the stock as easily to detach the lint from it. To build the hemp breaker and horse power, will probably not cost more than fifty or sixty dollars, and the whole is easily removed on a common wagon.

"When I saw it in operation, it was breaking water rotted hemp, which appeared to have been insufficiently rotted, but I was told by Mr. Denseford, his hands were then cleaning three times the quantity per day, that they had done without the aid of the machine.

"This machine will, I think, be a most valuable anxiliary to the hemp growers, as it will enable them so greatly to expedite the heaviest and most tedious part of their work. A boy of fifteen, will, with the hemp breaker by the machine, do the work of two men. I understand Mr. Denseford has take steps to obtained a patent."

Boston and Buffalo.—The great chain of railroad, between Boston and Buffalo, is made up of ten distinct links, all uniting with each other and presenting a continuous line. The length and cost of each work is thus stated in the New York Express. They are all completed except 39 miles, from Batavia (via Attica) to Buffalo:

	Length.		Cost.
1. Boston and Worcester, - - -	44½		$1,934,981
2. Western Worcester to West, Stockbridge, - - -	117		6,235,025
3. Albany and West Stockbridge, - -	38½		1,412,480
Total Boston to Albany, - -	200		6,582,386
4. Mohawk and Hudson, - - -	16		1,100,000
5. Utica and Schenectady, - - -	78		1,901,785
6. Syracuse and Utica, - - -	53		1,011,000
7. Auburn and Syracuse, - - -	26	(nearly	630,000
8. Auburn and Rochester, - - -	78	(nearly	1,500,000
9. Rochester and Batava - - -	32		399,876
Total completed - - -	483		16,125,147
10. Batava and Buffalo (via Attica) -	39	(estimate	500,000
Total Boston to Lake Erie, - -	522		$16,625,147

In the above cost of railroads in the State of New York, west of the Hudson river, the depots, engines, cars, etc., are included; it is probable that a further sum should be added for those items on part of the eastern lines, and the aggregate cost of the whole line from Boston to Buffalo may be put down at 16,000,000 of dollars. The distance from New York city to Buffalo by the same route is 472 miles, of which over 100 miles of railroads are yet to be made. From New York to Dunkirk, on Lake Erie, by the New York and

Erie railroad, including 22 miles of river navigation to Piermont, the distance will be about 468 miles, and the cost of the New York and Erie railroad is estimated at $9,000,000. Difference of distance to Lake Erie, in favor of New York over Boston, 54 miles, and difference of cost of railroads $7,000,000, also in favor of New York, when both chains shall have been completed.

Anthracite Coal Trade.— The immense value of the anthracite coal trade of Pennsylvania may be seen in the fact that the amount mined and sent to market this year will exceed 1,000,000 tons, worth in the market $5,000,000. In 1820 the first anthracite was sent to market, and then only 365 tons. It has been steadily increasing during the last 20 years, until it has at length reached 1,000,000 tons.

The following will show the amount shipped from the several mining districts :

Schuylkill, - - - - -	587,157	tons.
Maunch Chunk, - - - -	140.127	"
Lackawanna, - - - - -	195,480	"
Wyoming, about - - - -	47,000	"
Pinegrove, - - - - -	25,600	"
Shamokin, - - - - -	21,462	"
Lykens Valley, - - - -	1,000	"
	1,017,827	"

We have at length reached a 1,000,000 of tons. This amount would have been greatly increased had it not have been for several accidents. The great spring freshet so much injured the Lehigh improvements that no coal was brought down the canal until sometime in August. This prevented the mining on the Lehigh of at least 100,000 tons. The draining off of the dam by the Union canal company, thus shutting up the Pinegrove region in June, prevented 25,000 additional tons from being sent to market. The low water in the Susquehanna prevented 5,000 tons from being sent to market from Lykens Valley, making in all 140,000 tons. Next year 1,200,000 will be mined and sent to market.—*Harrisburg Intelligencer.*

Pennsylvania Lead.—It would appear from the following article in the Sunbury American that there is a fair promise that *lead* will be added to the list of mineral resources in which the State of Pennsylvania abounds so abundantly :

The lead mine discovered near Sunbury, is not, as some suppose, one of the humbugs of the day. Several miners have been engaged for the last six months, in driving gangways and making other excavations. During that time they have taken out about one hundred tons of good ore. We were informed by one of the miners that they have now extended the gangway almost two hundred feet into the hill, and that the vein of ore presents a breast of about five and a half feet. There are, in all, eight veins, imbedded in compact limestone. These veins are plainly visible, cropping out, as the miners term it, on the top of the hill, ranging from five to twenty feet apart. The workmen say that two hands can take out about fifty tons of ore per month. This ore, we understand, has been analyzed in New York and Philadelphia, and found to yield from 60 to 80 per cent., depending upon the quality of the specimens tested. We have seen bullets, cast from it by smelting some of the ore in an iron ladle, over a common smith's fire. Those interested in the work, intend to put up a smelting furnace early in the spring, when the whole matter will be fully and fairly tested.

A Great Work of Art—The Box Tunnel.—The Great Western railway, England, is a magnificent work, and is marked by many extraordinary indications of labor and enterprise. It is the longest independent line of railway completed in England. The "box tunnel," which forms one of its principal features, pierces through Box Hill, between Chippenham and Bath—part of which is 400 feet above the level of the railway. The tunnel is 9,680 feet long, 39 high, and 35 wide, to the outside of the brick work. The excavation amounted to 414,000 cubic yards, and the brick work and masonry to more than 54,000 cubic yards. About 30,000,000 of bricks were used. A ton of gunpowder and a ton of candles were consumed every week for two and a half years, and 1,100 men and 250 horses were kept constantly employed. For a considerable distance the tunnel passes through freestone rock, from the fissures of which there was at times an immense influx of water. This formed such an impediment, that the work was on one occasion discontinued for a long time. But the water was finally pumped out through the agency of a steam engine of 50 horse power, which threw it out at the rate of 32,000 hogsheads a day. The contractors, Messrs. Bremer and Lewis, deserve immense praise for their indefatigable exertions.

Private Economy of the Chinese.—The interiors of some of the houses were found beautifully furnished and carved; one that is now inhabited by governor, and believed to have been the property of a literary character, was, when first opened, the wonder and admiration of all. The different apartments, opened round the centre court, which is neatly tiled; the doors, window frames and pillars that support the pent roof, are carved in the most chaste and delicate style, and the interior of the ceiling and wainscot are lined with fret work, which it must have required the greatest nicety and care to have executed. The furniture was in the same keeping, denoting a degree of taste the Chinese have not in general credit for with us. The bed places in the sleeping apartments of the ladies were large dormitories, for they can hardly be called beds; at one corner of the room is a separate chamber, about eight feet square, and the same in height; the exterior of this is usually painted red, carved and gilt, the entrance is through a circular aperture three feet in diameter, with sliding pannels, in the interior is a couch of large proportions, covered with a soft mat and thick curtains of mandarin silk; the inside of the bed is polished and painted, and a little chair and table are the remaining furniture of this extraordinary dormitory.—*Lord Jocelyn's Six Months with the Chinese Expedition.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

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[For the American Railroad Journal and Mechanic's Magazine.]

PHILADELPHIA, *January* 4, 1842.

GENTLEMEN: Will you do me the favor to publish in your Journal my little pamphlet on "The Causes which have Conduced to the Failure of many Railroads in the United States," which is reviewed in your last number.

I would much rather that a knowledge of the principles which I advocate should be obtained from the pamphlet, as they are expressed in my own language, than from the version given by your correspondent.

Errors so palpable as those which I appear to have committed, could not do much harm before an intelligent community, under any circumstances; and now that they have been so ably met and so clearly exposed, by a logical and accurate writer, they may be read without the least danger to established practices.

You deal unfairly by me, in charging my views to inconsiderate haste, or confined observation. They are attributable to neither. They were formed long ago, and have been published before. Observation, study and intercourse with gentlemen who originally differed with me in sentiment, have not convinced me of my error. I have, for years, advocated, in writing and conversation, as correct maxims,

I. That railroads should be made with a proper regard to the business which they are intended to accommodate.

That strong roads and easy grades are appropriate for a heavy trade, and weaker and less costly roads, and steeper grades, should be adopted for a light trade. The *measure* of strength and the limit of steepness, being determined by the *amount* of the anticipated trade.

II. That a single track is sufficient in almost all cases.

III. That high velocities may be adopted for the conveyance of travellers, but that a very slow motion (five or six miles per hour) should limit the speed of transportation of heavy produce.

IV. That light engines, running on a cheap road, should be employed for the accommodation of a very small business, and powerful ones on a strong and heavy road, should be adopted for a very large business.

V. That small and light cars should be used for the small trade, and the conveyance of very few travellers, and larger, and stronger, and heavier ones where the business is sufficient to fill them, and authorise a road substantial enough to bear them.

VI. That the tariff of toll should be adapted to the ability of the articles, and subject to the laws which govern trade.

The pamphlet which you condemn aims to support some of these general maxims.

"Let Truth and Falsehood grapple." If my views be not sustained by common sense and an extensive experience, railroad companies will still continue to make large roads, and provide great power, and expend vast capital, for the transportation of a small trade. If, on the contrary, my suggestions be prudent and sensible, in course of time they will receive the sanction of public opinion.

Respectfully yours,

CHARLES ELLET, JR.

In introducing the criticism upon Mr. Ellet's pamphlet, in the last number of this Journal, it was remarked that we considered that it required immediate notice, our arrangements at the time did not admit of the insertion of the entire pamphlet, and we felt less anxious about doing so, presuming it to have been freely circulated among the profession. The idea of doing injustice to any one was far from us, and we least of all contemplated such wrong toward Mr. Ellet. The same reasons which have impelled him to write the paper, have compelled us to enter a caveat against what we conceive to be injurious to the cause in which we labor in common.

In the foregoing communication, the chief points insisted upon in the pamphlet are fairly propounded. We propose to make an examination of them for the sake of convenience, rather than refer to the extended paper which we give in full in this number. In so doing, we hope to be able to show wherein we differ from the writer and where we agree, thus narrowing the question down to the true issue, and affording a better opportunity of comparing the conflicting views.

"I. That railroads should be made with a proper regard to the business which they are intended to accommodate."

We give entire consent to this proposition, but there remains a question as to what this "proper regard" may be. The explanation which accompanies it, is open to the same question, and the latter clause is not such as we could agree to, without much qualification. The consideration of this point is incorporated with that of several others, and is given in the same place.

"II. That a single track is sufficient in almost all cases."

This is precisely in accordance with our views, and has been generally practised upon by the profession—very few roads having entire double tracks, and although graded for them in most cases, the additional width is not more than is actually required for a good and sufficient drainage, and the convenience of turn-outs, wherever they may be required.

"III. That high velocities may be adopted for the conveyance of travellers, but that a very slow motion (five or six miles per hour) should limit the speed for the transportation of heavy produce."

The only objection to this is the very slow motion assigned as the proper limit for transportation, we would rather say eight to ten miles per hour. The views of Mr. Ellet are, however, consistent in this respect, and his rate of five to six miles is a necessary result of his other positions.

"IV. That light engines, running on a cheap road, should be employed for the accommodation of a very small business, and powerful ones on a strong and heavy road, should be adopted for a very large business."

"V. That small and light cars should be used for the small trade, and the conveyance of very few travellers, and larger, and stronger, and heavier ones where the business is sufficient to fill them, and authorise a road substantial enough to bear them."

These two propositions are in intimate connection with each other, and must be noticed together.

The sixth proposition is one upon which all parties are unanimous.

The peculiar points of Mr. Ellet's views, upon which a difference exists, may be thus summed up:—

That the strength of the road, and consequently its cost—the weight and power of the engines, and the weight and strength of the cars are to be in exact proportion to the amount of the trade. At first sight, it may appear that these are mere truisms, and in a vague and general sense, they are such, but when we descend to their particular application, we find that there is a wide room for discussion.

In the first place, if correct in every other respect, these propositions will not hold good in a young and growing country. Every railroad that has been built in long settled countries, when properly conducted, has produced an increase of traffic upon the line. How then will it answer in a population increasing ten to fifteen per cent. in ten years, to limit the capacity of the work to the actual traffic, when all experience has proved that with a fixed population, a great increase must be expected? This is the true question,—by what estimate of traffic shall we determine the standard which is to regulate the power and capacity of the road and its machinery? If we take the actual and existing traffic, we shall then be prepared to give a more full assent to the correctness of Mr. Ellet's assigned cause of the failure of railroads. But can we, with any propriety, take such narrow views without at once diminishing the benefits of railroads in such a manner and to such a degree, as to deprive us of one of the most powerful motives to their construction.

It may be answered, that it is easy to reconstruct a road, and enlarge its capacity to any extent. But this is not the fact. When once the land along a line has been purchased, and the road is in operation, all property in its vicinity rises in value, and any additional purchase by the company must be made at an enormously increased price. Here certainly any economical advantage contemplated must be defeated. In like manner, a heavier rail cannot be substituted for a lighter one, without an increase of expense far exceeding the capital consumed in using from the first a heavy rail, together with the interest upon it. To counterbalance this, we have the transportation of the original rail to and from the ground, together with its depreciation in value.

The wood work being of a more perishable nature, and the machinery being locomotive, changes may be more easily effected, yet even here the advantages must be very small.

We must remember that the infant railroad is to be clothed in an iron suit, which can neither be altered nor stretched,—if we give him a tight fit at once, he never can grow any larger, and if we desire his future welfare, we must at first allow him some spare room.

But there is another view in which railroads of inferior capacity may be regarded as positive evils. Let us suppose a company of moderate capital to construct a cheap road between two cities, and that the capacity of this road is strictly limited to the actual traffic. Soon a vast increase of business accrues, as might have been expected, both from the growing state of the country and from the facilities offered by the railroad itself. But the company have not the means of increasing the accommodation, and do not desire it, as they have an ample return for their capital, and have the means of influencing prices and in fact of doing what they please, as they need not carry all the passengers, and having the advantage, can charge high fares. No other railroad company and no other means of conveyance would willingly enter into competition under such circumstances, and we have finally a downright monopoly of the most odious kind. We can form some idea of such a state of affairs by our own State works. The canal is deemed insufficient for the traffic, but the railroads are not allowed to carry freight, therefore the canal must be enlarged at an expense sufficient to construct a railroad of the most permanent character from New York to Buffalo, by the way of Albany and the Mohawk valley, and by the route of the Erie railroad. The causes are not exactly the same, but the effect is.

But if we attempt to make the traffic the *exact* measure of the strength and capacity of the road and its machinery, we find that in descending, a limit is soon reached at which the railroad possesses scarcely any advantage over a common road,—and yet under the same circumstances, an increased capacity would give it a decided advantage for speed and certainty over all other modes of communication. Thus, a substantial railway between two places not far distant, and with moderate business, might obtain the freighting and travel between the two, and even by its regularity and dispatch, do away with nearly all traffic by private conveyances, and actually induce persons to travel who did not before. But if a cheap road and inferior machinery were adopted, no such advantages could be held out, and rival modes of conveyance would increase, and in a corresponding degree would the business of the railway decrease with any decrease of expense. This is not imaginary, for we have seen a case in point,—the railroad was good, but the machinery inferior, and the management on the cheap system. Not one, but several stage lines were supported, and one parallel with the road, and in winter, with bad roads, averaging about the same time with the railroad cars, and sometimes actually passing them on the way. A railroad must absorb all the traffic, and to do this, must be substantial in its structure and liberal in accommodations.

In the same manner, the rate of carrying freight exercises an important influence—a speed of from eight to ten miles per hour, puts at distance all other rivals, while one of five to six is so little better than the transit by common roads, that not much is to be gained. On a weak and inferior road, freight can only be carried at a low rate of speed, and even then, more injury is likely to be done to the structure than heavier weights and higher velocities on a stronger road.

The proposal to employ cars varying in size and strength with the traffic is most singular, whether we regard its reference to economy, to safety, or to popular prejudices. This would be like regulating the thickness of the plank by the tonnage of the vessel in exact proportions. We are far from supposing that Mr. Ellet contemplated any such ridiculous extension of this proposition, yet there can be no doubt that the tendency of such a doctrine would be to injure the capitalists, and excite the prejudice of the travelling community. It would be far better to regulate the number, rather than the size and strength of the cars.

There is one consideration which has a powerful influence in determining this question. The travel on railroads as well as by all other modes of conveyance, is not uniform throughout the year—that of a few summer months being frequently several times greater that the average for the year. Now in such cases, unless the tide of travel is taken, and all of it taken at its flood, but little profit will result. Hence a provision must be made to meet the utmost demands; and this can only be accomplished at the expense of an establishment throughout fitted to the greatest emergency.

That a due regard should be paid to the extent and nature of the traffic, no one will dispute, but that any constant proportion should prevail, is not easy to be proved, even if we could decide upon the exact amount of traffic—in itself a matter of much uncertainty and liable to great fluctuations. Moreover, the experience of the past has shown, in many instances, that inferior capacity of the road and inadequate accommodation have been the cause of want of success, rather than that the other extreme had been reached.

In speaking of the capacity of the road, we have included character of grades, strength, structure and size, and power of locomotive and machinery. A few remarks may apply to these separately. The strength of the road and the weight of the rail must remain fixed, but the power of the engines may vary, though within much narrower limits than those proposed by Mr. E.; in the outset they may be of more moderate size and force than afterwards. There is a great advantage in having a strong structure even for lighter engines, as the efficiency of the latter depends much upon the former—an incipient traffic may be conducted more economically upon a heavy rail and structure, than upon one weak in proportion to the size of the engines.

Our doctrine then may be summed up thus:—

That roads should be constructed with a reference to the accommodation of the greatest amount of traffic likely to accrue, either by increase of population or by the advantages offered by railroad transportation. That the grades and strength of structure should be regulated according to the nature and direction of the greatest traffic (whether passage or freight, and whether up or down) and calculated to have rather an excess than a mere sufficiency of strength. That in the beginning, a smaller number of engines and cars may be used, and that, as a general rule, the number, rather than the strength, both for cars and engines, should be regulated according to the amount of business.

Lastly. That in everything, expedition, strength and safety, should be provided for, and that nothing should be considered costly that was absolutely necessary to them, and that nothing should be considered cheap, that did not fully satisfy the demand in all these respects.

Statements showing the amount of different articles shipped southward upon the Susquehanna Tide-water canal, during the year ending November 30, 1841.

Flour, barrels,	71,471
Wheat, bushels,	550,391
Other grains, "	196,780
Salt pork, barrels,	399
Bacon, pounds,	494,691
Butter and cheese, pounds,	384,648
Fish, barrels,	60
Sundries, pounds,	3,115,600
Rags, "	213,800
Cotton, "	197,442
Tobacco, "	2,086,064
Leather, "	262,366
Mineral coal, tons,	33,250
Iron ore, "	1,894
Iron, pig castings, tons,	18,753
Lime, bushels,	58,507

Limestone, bushels,	54,06
Sawed timber, feet,	6,011,779
Staves, shingles, headings, etc.	2,150,410

Statement showing the amount of articles shipped northward on the Susquehanna Tide-water canal during the year ending November 30, 1841.

Dry goods, pounds,	1,627,599
Groceries, "	9,129,975
Hardware, "	920,825
Queensware, "	611,140
Sundries, "	5,098,160
Plaster, tons,	8,338
Nails, kegs,	1,371
Salt, bushels,	78,013
Fish, barrels,	16,000
Shingles, number,	81,000
Lumber, feet,	29,395

Amount of tons shipped southward,	88,800	Tolls, $49,222
" " " northward,	20,600	" 21,045
Tons,	109,400	$70,267

The above shows a considerable increase of trade over the preceding season. A full two-thirds of this trade was carried to and from Philadelphia by steam towage, and the balance to Baltimore.

PENNSYLVANIA PUBLIC WORKS AND FINANCES. *From* GOVERNOR PORTER'S *Message.*

The subject of deepest interest, and greatest perplexity, that calls our attention, is the financial condition of the State. Although I have, on several former occasions, entered into a full and minute exposition of this matter, I cannot refrain from again presenting it to your consideration, in a manner so distinct and plain, as to preclude, I trust, the possibility of misconception on the part of those who feel an honest desire to understand it. I am persuaded that however embarrassed may be the pecuniary affairs of the commonweath, nothing is needed to induce the people to provide means to extricate them, but a clear and candid exposition of the nature and extent of the liabilities to which they are subject. The time for concealment, evasion and deception on this point, is at an end. The contract has been made. The faith of the State is pledged, and every consideration of duty and of honor require of us, to know our true condition, and to provide adequate means to meet our obligations, and to redeem our plighted faith.

There is due by this State to the United States, on account of deposite of the surplus revenue, the sum of $2,867,514 78. The funded debt of the State, amounts to $36,331,005 68. The debt is reimbursable as follows:—

1841 - - - - - -	$270,081 87
1844 - - - - - -	62,500 00
1846 - - - - - -	3,516,568 81
1847 - - - - - -	50,000 00
1850 - - - - - -	1,000,000 00
1853 - - - - - -	2,000,000 00
1854 - - - - - -	3,000,000 00
1856 - - - - - -	2,783,161 00
1858 - - - - - -	7,070,161 00
1859 - - - - - -	1,250,000 00
1860 - - - - - -	2,648,680 00
1861 - - - - - -	120,008 00
1862 - - - - - -	3,225,000 00
1863 - - - - - -	200,000 00
1864 - - - - - -	2,515,000 00
1865 - - - - - -	1,797,010 00
1868 - - - - - -	2,524,000 00
1870 - - - - - -	1,957,362 06
At the expiration of certain bank charters, - -	340,981 00
Total, - - - - -	$36,331,005 68

This debt has been contracted for the following purposes:—

For canals and railways, - - -	$30,055,013 68
To pay interest on public debt, - -	3,304,303 00
For the use of the treasury, - - -	1,581,689 00
" Turnpikes, State roads, bridges, etc., - -	930,000 00
" The Union canal, - - - -	200,000 00
" " Eastern penitentiary - - -	120,000 00
" " Franklin railroad, - - - -	100,000 00
" " Pennsylvania and Ohio canal, - -	50,000 00
Total, - - - - -	$36,331,005 78

The value of our public improvements, estimated at cost, is - - - - -	$29,292,165 33
The State owns bank stock which cost, at par	2,108,700 00
" " " Turnpike and bridge stock,	2,843,048 89
" " " Canal and navigation stock,	831,778 66
" " " Railroad stock, - - -	350,546 90
Money due on unpatented lands, estimated at -	1,000,000 00
Total - - - - -	$36,426,239 78

The immediate difficulty of our situation, arises mainly from the payment of the interest annually accruing on this debt. This interest is about $1,800,000; and this sum, it is incumbent on the

State to provide as it becomes due. The inconsiderable portion of the funded debt, now redeemable, can be, doubtless, postponed until more auspicious times, but the interest admits of no such postponement. This is in a great measure payable to those who cannot afford to procrastinate its reception, and whose means of substance depend on the faithful adherence of the State to its solemn engagements with its loan holders. The income especially appropriated to the payment of this interest, is derived from the following sources, to wit:—tolls on canals and railways, auction duties, tax on collateral inheritances, dividends on turnpike, bridge and navigation stocks, escheats and the tax levied on real and personal property, etc.

The amount received from each of these several sources, during the last fiscal year, ending 30th November last, is as follows:—

From tolls on canals and railways, - -	$762,360 44
" Auction duties, - - - - -	77,022 15
" Collateral inheritances, - - -	21,591 43
" Dividends on turnpike, bridge and navigation stocks,	30,355 72
" Escheats, - - - - - -	336 64
" Tax on real and personal property, etc. -	33,292 77
Total, - - - - - -	$924,959 15

The sum in the treasury, applicable to this object, on the first day of this month, independent of what will be received during the month, was $1,020,936 38, being $124,042 62 more than is necessary to pay the interest due on the first of February next.

These internal improvements, for the construction of which the principal amount of the State debt has been incurred, consists of 768¼ miles of canal and railways completed, and 165¾ miles of canal in progress of construction and nearly completed.

The finished works are the following:—

	Miles.
The Delaware canal, from Easton to tide at Bristol,	59¾
The main line of canal and railway from Philadelphia to Pittsburg, - - - - - -	395¼
Canal from Beaver, on the Ohio river, to Greenville, in the direction of Erie, - - - -	72¾
Canal from Franklin, on the Alleghany river, to Conneaut lake, - - - - - -	49¼
Canal, Susquehanna and North branch, from Duncan's island to Lackawanna, - - - -	111¼
Canal, West branch from Northumberland to Farrandsville,	73
Several side cuts and navigable feeders, - -	7
Total canals and railways completed, - -	768¼

Canals in progress and nearly completed:—

	Miles.
North branch extensions, from Lackawanna to New York line,	90
Erie extension, from Greenville to Erie harbor, -	62¼
Wiconissco canal, from Duncan's island to Wiconissco creek,	12¼
Total canals in progress, - - - -	**165¾**

The report of the Canal Commissioners, with the accompanying documents, which will shortly be laid before you, will show in detail, the state and condition of our public improvements. Having in former communications to the legislature, stated my views in relation to our system of internal improvements, I beg leave respectfully to refer you to them, as being unchanged, without wishing unnecessarily to extend this communication, by embodying them in it.

When I first entered upon the duties of the executive department, the question of completing the North branch and Erie extensions was submitted to the action of the legislature. The representatives of the people decided in favor of completing both, and have, by three subsequent acts, appropriated considerable sums of money for that purpose. The North branch canal has already cost $2,348,276 38, of which the sum of $389,676 42 remains yet due to contractors. The Erie extension has already cost about $2,919,507, of which the sum of $574,406 23, is yet due to contractors. The grave question is now presented to your serious consideration, whether, under all the circumstances, those two lines are to be forthwith finished, or abandoned for all time to come, and the entire amount of labor and money expended upon them thrown away. Contractors who have gone on to the work, and perhaps executed the least profitable part of it, will have fair claims on the justice of the legislature for remuneration, for the losses they have sustained by an abandonment of the work by the Commonwealth. Judging from the success which usually crowns perseverance in similar applications before the legislature, there can be little doubt that this class of claimants will not go away unanswered and unsatisfied. The farmer, whose lands have been cut up and destroyed, will also be a just claimant for compensation for the injury he has sustained, for which the advantages from the proposed canal will not be an available set off; and it may be well to inquire whether the amount of those claims would not go far towards the completion of those branches of our improvements. The only valid objection to a prosecution of these works to completion, is the difficulty to be apprehended in raising the necessary funds for the purpose. The estimated cost to complete the Erie extension, is $536,142 46, and the North branch, $1,298,416, independent of the arrearages due contractors, as before stated, which must be paid at all events. More confidence can be placed in the accuracy of these estimates of the cost of completing these works, than could be extended to those made in the early stages of our public improvements, from the increased practical experience of those intrusted with the duty of making them. My own opinion remains unchanged, that it is our true policy to go on and complete both these works with as little delay as possible. This, however, is a question exclusively for your decision.

For the debts now due to contractors on these lines, as well as for repairs on the other lines rendered indispensable, and without which many portions of our canals would have been unavailable and useless throughout the season, I respectfully urge that some prompt and immediate provision be made. Many of the contractors have laid out their money for a long time, and have suffered serious injuries by the delay. If no better expedient can be devised, I would recommend the immediate issuing of a six per cent. stock, to all such creditors, redeemable at such time as shall be thought most expedient.

The amount required to pay debts due for repairs on the several lines of canal and railroad, it will be observed by the report of the Canal Commissioners, is unusually large. This is to be ascribed to the unprecedented breach which occurred in the Delaware division, in January last, which cost about $150,000; to the renewal of the north track of the Columbia railroad, to the rebuilding, in a permanent manner, the locks, bridges and aqueducts on several of the divisions, and particularly on the North branch, where the original superstructures, composed entirely of wood, had so far decayed as to leave no other alternative, than either to renew them throughout, or abandon the navigation entirely. It is also, in part, to be ascribed to the fact that only a portion of the funds appropriated by the act of the 4th of May last, for repairs, and to pay the debts then due, became available, leaving a large balance of the appropriations to these objects, therein authorized, still due to the public creditors.

There is always, even under the most economical administrations of affairs, a greater amount of expense incurred in managing and keeping in repair great public improvements for the Commonwealth, than it would cost if they were in the hands of individuals. It is, therefore, respectfully suggested for the consideration of the legislature, whether the public interest would not be promoted, and the amount of State debt considerably lessened, by a sale of the canals and railroads belonging to the Commonwealth, or at least, a portion of them, or such other disposition as would diminish their annual expenses to the Commonwealth, and increase the amount of revenue from them.

Were the Commonwealth free from debt, I should hesitate to recommend the sales of any of her public improvements. But oppressed as she is, the cost which the repairs require, and the necessity of relieving ourselves as far as possible, induce me to urge action on this subject, at least so far as regards the Columbia railroad and the Delaware division of the Pennsylvania canal. It will matter but little to those interested in the use of the improvements, whether they are in the hands of the public or of individuals, provided proper safeguards are enacted to protect the public in the free use and enjoyment of them, and to guard against abuses and exactions.

If it be objected that sales cannot be effected in the present state of our pecuniary embarrasments, that will be no reason why a law should not now be enacted authorising the sale of such portions of them as shall be deemed proper, subject to the approbation of the legislature on the sale being reported. If sold, even on an extended credit, if the principal be secured, and the interest punctually paid, it will so far relieve the Commonwealth. If it were made a condition that State stock should be received in payment, it would probably make the sale more advantageous to the Commonwealth. The disposition of capitalists would thus be made known, and it can, at least, be ascertained whether a sale at an adequate price can be effected. The policy of leasing for a term of years, one or both of those improvements, has been more than once suggested. Of the propriety of so doing, I am not prepared to express a decided opinion, but have thought it worthy of a suggestion for your consideration.

That the public works should be unproductive, is owing in a great measure to a want of proper legislation on the subject, and unless this be remedied, it must impair public confidence in their ultimate utility. The Canal Commissioners have repeatedly urged upon the legislature the propriety of allowing the Commonwealth, alone, to carry the passengers on the Columbia railroad. No railroad in the United States could sustain itself, if it were to relinquish the carrying of passengers, yet on that road this strange condition of things is exhibited. The State has expended in its construction over four millions of dollars, where the capital employed by those carrying the passengers, is perhaps thirty thousand dollars. The State, on her immense outlay, is reaping about three per cent., while the individual carriers on their thirty thousand dollars, are clearing nearly two hundred per cent. So it is also with regard to the transportation between Philadelphia and Pittsburg. That line of our improvement between those cities, was constructed at a cost of a fraction over fourteen millions of dollars. The transportation on it is monopolized by some seven or eight companies, employing a capital of less than four hundred thousand dollars; yet, while the State is receiving little more than will keep it in repair, the transporters are realizing immense profits, and that too, on a comparatively small outlay.

This can only be remedied by vesting the Canal Commissioners with full and ample authority to adopt such measures, as in their judgment, will be best calculated to enlist individual enterprise, and invite competiton, and to counteract the effects of the selfish and monopolising system that has controlled, and now controls, the transportation on our public works,

It may possibly be supposed that the Canal Commissioners possess adequate power already for this purpose, but this is to mistake the case. From the nature of that department of the goverment, it is always made the target at which the discontented and interested point their shafts. Not a session of the legislature passes without harassing the commissioners with investigations,—the whole State is ransacked for accusers,—every act is questioned and misrepresented, and after all, the result is fruitless. The first instance is yet to be found, in which any thing tangible has been produced, or any salutary reform of the system effected. Were the legislature to devote one session to an honest and thorough examination and correction of the abuses and defects of the system, without annoying and pursuing individuals for sinister ends not openly avowed, much good would be produced; but, under any other mode of treating this subject, the issue must be as idle and frivolous as heretofore. I do not wish to preclude the most searching investigation. I merely desire to direct your attention in a channel that will be beneficial to the public.

One of the greatest evils of these frequent and frivolous investigations is, that they bring legislative investigations themselves into discredit. The persecution of the innocent, always furnishes a shield to the guilty.

It is now, throughout the country, a matter of idle sport to talk of these investigations. The mode by which they are brought about is well understood. A few dissatisfied contractors, and others, impose on the credulity and stimulate the ambition of some member of the legislature to offer a petition, complaining of public grievances. A committee to investigate is appointed ;—subpœnas are issued, and straightway, swarms of hungry confederates throng the seat of goverment, to prosecute their claims before the legislature—to lounge at the public expense, and join in a wholesale pillage of the treasury. At the close of the session the committee reports,—the witnesses return to their homes, and laugh at the trick, as they pocket the spoils. By reference to this subject, it will be found that a large portion of the legislative expenses is incurred in this way. The extraordinary increase of these expenses, over those of all other departments of the goverment, has been of late years a matter of just complaint.

EXPOSITION OF THE CAUSES WHICH HAVE CONDUCED TO THE FAILURE OF MANY RAILROADS IN THE UNITED STATES. *By* CHARLES ELLET, JR., *Civil Engineer.*

There are completed, or in progress of construction, between three and four thousand miles of railroads in the United States, on which there has been expended, during the last ten years, more than one hundred millions of dollars, and for the maintenance of which there are now required annual appropriations of several millions, in addition to the loss of interest on this vast capital.

Of these works, some few have thus far sustained themselves, and distributed considerable dividends among their stockholders ; the receipts of some others are sufficient to keep them in repair, and pay the interest on the loans incurred for their construction ; but of the balance,—comprising between one and two hundred railroads, having an aggregate length of some two thousand miles,—the capitals may be regarded as positively sunk, and many of the companies as insolvent.

This disastrous result is not the consequence of attempting improvements in positions where the trade and travel were insufficient to authorize the necessary outlay of capital, but proceeds from the fatal practice of imitation, and a thorough disrespect of first principles.

The roads constructed by these unfortunate companies, instead of being such as appeared to be justified by the condition of the country in which they are situated, were only such as the engineer, or president, or leading stockholder had somewhere seen or read about. In the beginning, there was no particular object proposed to be attained ; and in the progress of the work, there was nothing to rule the general plans, or govern the arrangement of the detail,—and they failed of course.

The object of a railroad is to convey passengers and produce; and the first question which every company, about to embark in such an enterprise, should propose for examination, is, What is the amount of trade and travel to be accommodated? for this amount furnishes us the value of the object sought by the improvement, and ought to prevent us from paying more for it than it is worth. And the second is, What should be the location and character of the road, and the character of its furniture, for the economical accommodation of the trade which it is found may reasonably be anticipated?

These are the essential questions for solution; but as obvious as the necessity for their investigation may appear, they have rarely, if ever, been systematically examined preparatory to engaging in the labor of construction. The amount of trade to be accommodated has never yet governed the plan, location and execution of any public work. All such enterprises in this country, and indeed nearly all the railroads in the world, bear one common impress, and every important sign of imitation of one common standard. They are all struck, as it were, with the same die, and belong to the same set. The same width of track, the same strength of rail, engines of the same weight, and cars of the same magnitude, prevail on the roads between the great cities of Europe, which carry half a million of tons, and some hundreds of thousands of passengers every year, and on those of the obscurest districts of the United States, where as many persons, and as much trade, will scarcely be witnessed in the course of half a century.

The imitation is universal. The same powerful engine, with its vast cars, is driven when loaded with a hundred tons of freight, or more than a hundred passengers, as when conveying its mere "tender" and empty train. It is so universal that the expenses of transportation are now frequently estimated by ascertaining the number of times the engine passes over the line, without any reference at all to the load which it draws. A late distinguished engineer, who had recently visited all the railroads in the Uuited States, published, as a result obtained in his investigations, that it costs one dollar per mile to run a locomotive engine, and its train, on a railroad,—a result which he announced as a general fact, without qualification, and is nearly independent of the number of passengers conveyed, the distance travelled, or the tonnage forwarded. In other words, he came to the conclusion that it cost as much to send twenty passengers by railroad as it does to send two hundred, (providing they are carried by a single engine and train,) and as much to convey ten tons as to carry one hundred tons. Waiving the objections which may be urged against the generality of this conclusion, it must be admitted that, within certain limits, it is very nearly true, and precisely what ought to be anticipated from the facts. The rails, engine and cars are almost as much injured; the same capital is invested in the road and its furniture, and the same power and entire outfit are required, whether the trains be full or empty. The expenses could not, therefore, be expected to vary much with the amount of the load.

And now, it may be asked, what is there wrong in all this? The company can only be expected to make the improvement, and provide for the business which it may have to perform—it is for the public to fill the trains.

The error consists simply in providing a power too great for the business to be done. There is scarcely an engine on any railroad in the country which is not competent to the movement of more than a hundred tons; and if such an engine make but two trips a day, and convey always a full train, it will carry nearly 150,000 tons in the course of the year. Now, there are nearly two hundred railroads in the United States, which are provided with all the locomotive power, and nearly all the means of doing a much greater business than this, and which have not the tenth part of this amount of business to do. There are few railroads in the country, over which twenty-five thousand tons of freight are carried in the course of a year. Here, then, is a great error. The road and its appurtenances, are a piece of machinery contrived to perform a certain duty; but so proportioned, by unskilful workmen, as to be ten times larger than is necessary; and consequently, ten times the capital is consumed in its construction, and nearly ten times heavier expenses than are really needful, are constantly incurred to keep it in operation.

To illustrate the case, I will suppose, that a stage proprietor has two routes on which he is compelled by contract to carry the mail and all passengers who apply; on one of which he knows that there will be at least ten persons and a large mail every day; and that to accommodate the public satisfactorily, he must employ a Troy built stage, and four good horses, adequate relays, and skilful drivers. He knows, too, that on the other—a remote and obscure route—there can never be more than two or three passengers, frequently none at all, and a mail-bag equal to a school-boy's satchel, all of which could be conveniently carried in a light one-horse wagon. But being conscious of the dignity of his calling, and ambitious to sustain it; and having, withal, certain preconceived notions of what constitutes a "stage line," he determines, at once, to put four-horse coaches on both routes. With a knowledge of these facts, should we be surprised to hear him affirm, at the end of a year, that it does really cost very nearly as much to run his team on the obscure line as on the popular thoroughfare—to drive his heavy and empty four-horse coach over its daily route as it does the full one—or to hear him complain that staging is a losing business?

Yet this man is no less wise, no less provident, no less skilful in the conduct of his business, than are the directors of nine-tenths of the railroad companies in the United States. *They* do not proportion their roads, engines and cars, to the business to be done; nor do they seem to have glanced at the *objects* for which their works were intended, with a view to adapt them to their accomplishment. They commit the error which I have attempted to illustrate. They make costly roads, build expensive superstructures, rear extravagant edifices to contain their cars and engines, run heavy locomotives, and use carriages almost as capacious as dwelling houses, to carry as many passengers as could without much inconvenience be drawn in a hand-cart. There is no exaggeration in this description. Every traveller must have witnessed it on all the branch roads over which he has had the misfortune to travel.

In short, the roads of this country, and all the departments connected with them, possess a power, without proportion, greater than the business of the country will warrant; and *this is one of the causes* of the failure of the system.

Again, the same error which occurs in the first plan and future management, characterizes the construction of the road.

Before laying the rails, a certain operation is performed, which is called "grading," by which is understood the taking off the tops of hills, and filling up of hollows, so as to reduce the whole line to a succession of levels, or very uniform inclined planes. This work is apt to involve an outlay, varying from five thousand to thirty thousand dollars per mile—the exact amount depending on the fancy of the company, or on the formation of the country, but wholly independent of the amount of trade to be accommodated.

I have witnessed—to name one case out of a multitude with which it may be appropriately compared—an expenditure of more than three hundred thousand dollars, in a space of twelve miles, for grading a road, which has never enjoyed a trade exceeding six thousand tons in a year. The interest on this capital amounts to eighteen thousand dollars per annum, or considerably more than it would cost to send in wagons all the tonnage for the benefit of which it was expended.

The object of a railroad is to reduce the cost of transportation; and the object of cutting down hills and raising valleys, is to enable us to carry the trade over the gentler ascent, cheaper than it could be taken without the expenditure. The capital appropriated ought not, therefore, to be so great, that the interest on it would exceed the cost of doing the business without the facilities acquired by the sacrifice. In all such works there should be an object in view, and this object, whatever it be, must have its value. If the trade be two hundred thousand tons per annum, and it be desired to reduce the acclivities of the ascents so as to save one cent per ton per mile, it is obviously proper to expend a capital which would produce two hundred thousand cents a year. For such an object it would be admissible to expend some $33,000 per mile in the construction of the road;—but not more than that. But if the trade were only six thousand tons, as in the case to which I have adverted above, it would not be good economy to expend a greater capital for this object than would yield six thousand cents per annum, or about $1,200 per mile. But what was the practice on this line, and what is the practice on a hundred others like it? It is to cut down hills and fill up cavities, on the most insignificant roads, of a magnitude that should cause the strongest company in the country to pause, and consider well and maturely before venturing to encounter them. The company of which I have spoken, and others that I need not name, have expended $25,000 per mile in grading a road, to accommodate an amount of trade and travel which could have been carried forever by two or three locomotive engines of two tons weight, on a road which need not have spoiled more than a width of ten feet of ground, and which, with all its essential fixtures, could have been built for two thousand dollars a mile. They expended twelve times the capital that was necessary, and they incur yearly expenses as many times greater than are really called for, in consequence of having laid out too great a capital. This is another of the errors to which I have adverted.

I will add a word in reference to the remedy.

It should be the business of every company, first to ascertain the trade and travel on the line where it is proposed to operate; and next, to build the road and stock it, with reference to the amount of business previously determined. This advice is so obviously correct—its propriety so evident—that it may be supposed the practice recommended could scarcely have been neglected. But, self-evident as it may appear, I am sustained by the history of our improvements in asserting, that it has never yet been observed.

If the company can anticipate but *eighteen or twenty passengers* a day, let them make a light wooden road—avoid the use of iron nearly or quite altogether—make no embankments or excavations, and follow very closely the undulations of the soil, as they occur under a skilful location of the line. Let them calculate, at every point the expense of removing obstacles, and never lay out more money to reduce a grade than the value of the additional power necessary to carry the eighteen or twenty passengers over it. Let them put on engines of *half a ton, one ton*, or *two tons weight*, instead of ten or twelve tons, with power only adequate to the certain accomplishment of the duty to be performed, and let them provide cars as light as one-horse pleasure carriages. Such a road, in ordinary cases, would cost from one to two thousand dollars a mile, instead of twenty thousand; such engines would cost but five or six hundred dollars a piece, instead of six or seven thousand; and such cars could be made for two hundred dollars, in place of twelve hundred. Let them build a car and engine shed, twenty feet square, at a cost of fifty dollars, instead of laying out, all along the line, some thousands for that purpose. Instead of a host of agents to keep up the road, to watch the track, to clean out ditches, repair embankments, feed the vast engines and move the huge cars, let them employ one faithful hand as engineer, conductor, fireman and treasure, and another, if the road be not *very* small, as superintendent and general commissary.

Such is the establishment to be recommended for such a case. And let it not be supposed that this is too contemptible an affair to be called a "railroad." The slight engine would possess sufficient power for the duties exacted of it; the carriages, though light, and comparatively cheap, would be exceedingly comfortable, and even elegant; the stock would be a profitable object of investment; the line and its furniture would not be too large to be kept in good repair; the public would be well accommodated, and—a consideration not to be treated with entire contempt—the company would either have no debts to pay, or be capable of paying them. The road, if ten or fifteen miles long, would cost but $20,000, instead of $200,000; the annual expense would be but $200 per mile, instead of $2,000; and the gross income of the cheap road—in consequence of its occupying the same ground, and being less liable to accident—would be positively greater than that of the other.

I put it to one hundred railroad companies which are now lingering out a sickly existence, to say, under the light that experience has afforded them, whether the adoption of these recommendations would not have been their better policy; and I put it to those companies that have not yet gone quite far enough to ruin themselves, to consider whether it would not be better for them to pause, even now, and examine their condition before they go further.

If they have not yet laid their superstructure, and exhausted their resources, there may be time to change, and extricate themselves from ruin, their capital from the gulf of endless expenses. They may doubt the correctness of my views; they may doubt whether any other sort of engines, any other cars, or other roads than those in use, could be advantageously employed. They may rely on what they call the public judgment, which has settled down in favor of the present system. This may seem well, but it would be better to use their own judgment. Let them ask whether it can be judicious—put the question their common sense—whether it can be necessary to employ a locomotive engine of seven tons weight and twenty horses power, two or three agents to manage it—a tender of three or four tons weight—one or more enormous cars—making altogether a moving mass of fifteen or twenty tons—and construct a road adequate to bear it all, and use fuel enough to drive the machiney of a large manufacturing establishment, to convey a load of ten or a dozen passengers?

If railroads do not sustain themselves, it is not because they are railroads, but because great roads have been constructed where little ones only were required. I do not believe that there has ever been such a work commenced, nor probably authorized, which could not pay a liberal and honest dividend, if the road, stock and entire apparatus, were duly proportioned to the duty to be performed.

The road and arrangements that are appropriate enough between London and Birmingham, or Liverpool and Manchester, would do but a small business, I imagine, if transferred to the prairies of the West. In fact, the people of Illinois have found it so. The power contrived to drive a grist-mill, would make but small dividends if applied to turn a churn.

It is far from my object to advocate the exclusive employment of cheap roads, and light stock; my intention is only to recommend them, as I would a light carriage, or light machine, where true economy, convenience and comfort dictate their adoption. A larger business will demand more extensive preparations; and in this connection, I will repeat remarks which I have elsewhere written when discussing this subject under another form: " An increase of business will give rise to improvements in the system adequate to its wants; and we must not consider a canal liable to breaches, with single locks and of imperfect construction; nor a railroad with an insecure foundation, liable to derangement from frost, and to obstruction from slides, and traversed by locomotives equally inadequate, as the means that would be provided to give passage to the whole trade of a continent. When the business created by a population of many millions has to be transacted along the line of canal or railroad, every resource that can be obtained from the increasing application of science and art, will be brought in requisition. The canal will be provided with an additional towing-path, and as many locks as are necessary; the valves will be adjusted to the time of filling essential to the purpose; the banks will be strengthened until breaches are impossible, and protected against the waves by an indestructible material; the mountain streams will be passed under, and the washings of every acre will be discharged through adequate openings. The railroads will be still more improved; their foundations will be more permanent, the rails will be more substantial, the drainage will be perfect; the weight of the engines will be increased, the cars made more convenient, and the trains, if necessary, will be driven by a power adequate to the management of a thousand tons.

"Under such circumstances, the transhipments will take place at points where the population of great cities may engage in the shifting of the produce from the boats to the cars, and from the cars to the boats. The lines will terminate where they can approach the shipping, and the trade at the port need only be limited by the capacity of the improvement."*

These remarks were written in discussing the possibility of giving vent to the whole of the surplus produce of the valley of the Mississippi, when much more highly improved than it will be in the next quarter of a century, by a single railroad from the Ohio to the Atlantic.

My intention is to advocate nothing exclusive. I propose to place large roads and strong roads, and easy grades and powerful engines, where there is a trade to justify the necessary expenditure. But to make the provision in all cases commensurate with the duties to be performed—the trade and travel to be accommodated. The fulfilment of this condition will exact the adoption of engines of every capacity, from that due to a half ton, up to twenty-five tons weight, and of roads adapted to the power of the engines. I recommend the use of means proportional to the end to be accomplished.

PHILADELPHIA, *November* 20, 1841.

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ENGINEERING WORKS OF THE ANCIENTS.

Dionysius of Halicarnassus, who lived in the time of Augustus, is the next author who contributes to our series, having extracted from his Roman Antiquities the following accounts of Roman works:

* Essay on the Laws of Trade, p. 105.

Bridge over the Tiber.—Ancus Marcius, the 4th King of Rome (B. 3, ch. 14,) is said to have been the first who built over the Tiber the famous wooden bridge, which is considered as sacred. It must only be made of wood, and neither iron nor copper may be used in it. When any damage occures, it is the duty of the pontiffs to see to the repair, and to perform certain sacrifices prescribed by law during the progress of the works.

Ancus Marcius greatly enlarged the city of Rome, and built the port of Ostia at the mouth of the Tiber.

Sewers.—Tarquinius Priscus, the 5th King (B. 3, ch. 20,) built the walls of Rome of large squared stones, and commenced the sewers, by which the waters are collected in the streets of the city, and carried into the Tiber. The work is admirable, and beyond any thing that can be said. For my own part, I believe that Rome has nothing more magnificent, nothing which better shows the grandeur of her empire, than her aqueducts, streets, paved roads, and sewers; I judge thus not only on account of their utility, but still more on account of the immense outlay which they have required. To prove what I assert, I will only instance the sewers. According to Caius Aquilius, having been for some time so neglected that they were stopped up, the censors concluded a bargain with a contractor to clean and repair them for a thousand talents.

We cannot pass over this tribute of the old historian without remarking that while the temples of Greece are scattered in ruins, and their proudest ornaments become the trophies of barbarians, the roads, aqueducts, and sewers of the Romans still minister to the wants of nations, centuries after the power of their founders has ceased to exist. The English emulate the Romans in the useful nature of their enterprises, and we trust that the labors of our engineers may minister as long to the service of the world as those of their predecessors.

Great Circus.—Tarquin also embellished the Great Circus between the Aventine and Palatine mounts, and was the first who constructed around this circus covered seats, whereas the practice formerly was to place scaffolding around.

Tarquinius Superbus.—Tarquin the Proud (B. 4, ch. 10,) the seventh and last king of Rome, employed the people on the public works in order to occupy them and prevent them from plotting. He continued to the Tiber the sewers begun by his grandfather, and carried out several of his unfinished works.

Strabo.—Having thus dismissed Dionysius of Halicarnassus, we come to Strabo, one of the most celebrated of the geographical writers of the ancients, and from whom, as from Diodorus Siculus, much information is to be gleaned as to ancient mining, a most important branch of engineering, as bearing upon earthworks. We shall first take the third book.

Mines in Spain.—A chain of mountains, (the Sierra Morena,) parallel to the Betis (Guadalquivir) extends towards the north, approaching more or less the banks of the river; it contains a great many mines. Silver is found everywhere in the neighborhood of Ilipo and Old and New Sisapone (Almaden.) Near the place called Cotinas, gold and copper are worked together. The mountains on the banks of the Anas (Gaudiana) also contain mines.

From Turdetania is exported cinnabar equal to that of Sinope, There is also found fossil salt.

What renders Turdetania particularly remarkable is its excellent mines. In fact all Iberia is full of them; but Turdetania unites all the advantages of a mining country to a degree which surpasses any praise. In no country in the world do we find gold, silver, copper and iron in such quantity or of similar quality. Gold is obtained not only from the mines but also from the rivers and streams, in which it is contained mixed with sand. It is also to be found in many dry places, but with this difference, that in these it cannot be distinguished at sight, while it shines when covered with the water. This is the reason why water is made to pass over sandy places, to make the particles of gold shine. Wells also are dug, and many means have been invented for separating the gold from the sand by washing, so that there are more gold washing works in the country than mines. The Gauls assert that their mines, as well as those of the Cevenes as those of the Pyrenees situated on their side, are better; but, nevertheless, the mines on the Spanish side are generally more esteemed. Among the particles of gold are sometimes lumps of gold weighing half a pound, which are named *pales*, and require very little refining. In cutting stones of ore, small lumps of this metal are sometimes found. After having roasted the gold intended to be purified, by means of an aluminous earth mixed with it, the result of the operation is the alloy of gold and silver known under the name of *electrum*. It is again placed in the fire, which separates the silver, and leaves the gold pure; for this latter metal is easily fused, and is not of much hardness. It is also fused sooner by the flame of staw, which, being milder, agrees better with the nature of gold, which obeys its action, and dissolves easily, while charcoal, being stronger, consumes a great part by liquefying it too soon, and converting it into vapor. As to the beds of rivers, the particles are extracted, washed in buckets, or in wells or holes made near, and the earth is washed. The furnaces for melting silver are generally made higher, to enable the pernicious vapor of this metal to rise and be dispersed. Some mines of copper have the name of gold mines, whence it is presumed that they formerly supplied this metal.

Posidonius, in speaking of the number and excellence of these mines, used all the exaggerations of an enthusiast. The Turdetanians, says he, use the greatest industry and labor in digging winding galleries far into the earth, and often in draining, by means of Egyptian spirals, the subterranean streams with which they meet. But their lot, he observes, is very different from that of the miners of Attica, to whom may be applied the ancient enigma, "They have not taken all that they have drawn from the earth, and they have left there what they possessed." The Turdetanians, on the contrary, draw from their mines enormous profits, since the fourth of the earth which they extract from the copper mines is pure copper; and the silver mines furnish private individuals in three days with a quantity of this metal equivalent to a Euboic talent. As to tin, according to the account of Posidonius, it is not found on the surface of the earth, as some historians assert, but it is also extracted from mines. Mines of this metal are found among the barbarious people who inhabit beyond the Lusitanians and in the Cassiterrides islands, and tin is also brought from the British islands to Marseilles. Among the Artabri, in Gallacia, the last people of Lusitania, on the north and west, there is earth covered with a dust of silver, tin, and of the metal, known under the name of white gold, on account of its alloy with silver. This dust is brought down by the rivers, raked up by the women, and then washed by them in sieves placed upon baskets. This is what Posidonius says as to the mines of Iberia.

Polybius, in speaking of those of silver which exist near New Carthage (Carthagena) says that they are 20 stades from the city, that they are so great that they extend over a district of 400 stades in circumference, that they habitually employ 40,000 workmen, whose labor brings to the Roman people 25,000 drachms per day (about £350,000 per annum.) I do not enter into the detail of all the other operations, which would be too long, I confine myself to what Polybius says as to the manner in which the silver is treated, which is contained in the rivers and torrents. After having pounded and sifted it over water, what remains is seperated from the water and pounded again; after having been sifted again, it is pounded and sifted five times in all. After this the pulverized matter is melted to separate the lead contained in it, and the silver remains pure. These mines of silver still exist, but there and elsewhere they belong to the State no longer, but have been taken possession of by private individuals; those of gold on the contrary mostly belong to the State. Here as well as at Castalon (Caslona) and in other places are mines of lead, which contain silver, but in too small quantity to defray the expense of seperation.

A little way from Castalon is the mountain whence the Betis (Guadalquivir) springs; it is named the Silver Mountain, on account of the mines of that metal which it contains.

Lusitania is watered by great and small rivers which contain many grains of gold. Although the country abounds in gold, the inhabitants prefered living by plunder.

The mountains in the neighborhood of Malacca (Malaga) contain in several places mines of gold and other metals.

Not far from Dianium (Denia) are very fine forges.

Works in Spain.—In the neighborhood of Asta (Mesa de Asta,) Nebrissa (Lebrisa,) Onoba (Gibraleon,) are canals dug in several places to facilitate the navigation.

Near Cadiz is to be seen the Tower of Cæpio, built on a rock, washed on every side by the sea. This admirable work was constructed in imitation of the Pharos of Alexandria.

Scilly islands.—The inhabitants trade in the tin and lead which they dig from their mines. Publius Crassus, who went there, found that their mines are not very deep.

Works in Gaul.—The extracts which follow are from various books.

Marius, perceiving that the mouth of the Rhone was becoming gradually shoaled up, had a new channel dug, which received the greater part of the waters. This canal he gave to the Marseillese in recompense for their service in the wars, and it became to them a great source of riches on account of the dues which they levied on those who went up or down.

The road from Iberia to Italy passes through Nimes. It is good enough in summer, but very bad in winter and spring, on account of the rivers overflowing and depositing mud. This road passes several rivers by boats, or by bridges of stone or wood.

The territory of the Cevennes abounds with gold mines.

The Tarbelli, a people of Aquitaine, are in possession of the most esteemed gold mines; for without digging deep, lumps of gold as big as the hand are somtimes found, requiring only a slight washing. The rest of the mine consists of grains and lumps, which do not either require much work.

Britain.—Britain produces gold, silver, and iron.

Lipari.—Lipari has very productive mines of alum.

Roman roads and bridges.—The Romans, says Strabo, have principally employed themselves upon what the Greeks have neglected —I mean paved roads, aqueducts, and those sewers which drain the city of Rome. In fact, by cutting through mountains and filling up valleys, they have everywhere throughout the country made paved roads, which serve to convey from one place to another the goods brought by sea to the ports. The sewers of Rome, arched with dressed stone, are broad enough in some places for a cart laden with hay to pass; and the aqueducts bring water in such abundance as to form streams running across the city, cleansing the sewers, and are sufficient, as it may be said, to supply all the houses with great fountains, canals and reservoirs. This last advantage is principally owing to the cares of Marcus Agrippa, who has decorated Rome with many other public monuments.

The principal of the great roads which traverse the country, are the Appian Way, the Latin Way, and the Valerian Way.

According to modern account, theValerian Way was about 100 miles long; for the first 15 miles are found ruins of bridges, causeways, etc. Beyond, the remains of it are not so evident, but the boldness with which it is carried across three mountain chains is surprising.

Near the city of Como, to master the people disposed to robbery, roads have been constructed, which are as practicable as it is possible for art to make them. Augustus, not content with clearing the roads of the banditi, has made them as convenient as possible, although the country is very difficult.

M. Emilius Scaurus constructed the Emilian Way running to Sabbata and Darthon; and there is another Emilian Way, which continues the Flaminian Way, and was the work of M. Emilius Lepidus, colleague of C. Flaminius. (This is an error of Strabo in attributing the Flaminian way to this Flaminius.)

The Salarian Way is a great road very short. To it joins the Nomentan Way.

The Appian Way is paved from Rome to Brendisium (Brindisi,) and is the most frequented of all the roads made in Italy. Beyond Terracina on the Roman side, the Appian Way is bordered by a canal, which receives the water of the marshes and rivers. It is particularly by night that this way of the canal is preferred; upon it people embark in the evening, and leave it in the morning, and take for the rest of the journey, the Appian Way, but even in the day-time the boats are towed by mules.

Near Baiæ is an isthmus of a few stades, through which a road is tunnelled. Near Naples is a similar one, which, in the space of several stades, crosses the mountain situated between Neapolis and Dicearchia. Its breadth is such that carriages which meet find no difficulty, and light is admitted by several openings pierced internally from the surface of the mountain through a great thickness.

The Aternus (Pescara) in the country of the Peligni is passed by a bridge 24 stades from Corfinium.

Canals,—The greater part of Transpadane Italy is full of lagunes, and therefore the inhabitants have made canals and dykes as in Lower Egypt, a part of the inundated ground being drained and the rest navigable.

Epiterpum, Concordia, Atria, Vicetia. and some other small places in the neighborhood of Ravenna. by small navigable canals, communicate with the sea.

The Cispadane was for a long time covered by marshes, which arose from the superabundance of the waters of the Po, but Scaurus, by having navigable canals dug from Placentia to Parma, drained the plain.

Ravenna is a great city built on piles in the midst of the marshes, and intersected with canals, which are crossed by boats or bridges.

Dyke.—The Locrine Gulf in its breadth extends as far as Baiæ, and is separated from the external sea, in a length of 8 stades by a dyke broad enough for a great wagon to pass. This dyke it is said is the work of Hercules; as in rough weather the waves flowed over it so as to make it impassable for foot-passengers; Agrippa had it raised higher.

Timber.—From Tyrrhenia (Tuscany) is obtained timber for building, of which is made very long and straight beams.

Pisa supplies timber for building much used by the Romans.

Cement.—Dicearchia or Puteoli has become a place of great trade, on account of the works by which it is sheltered, having in the sand of the neighborhood (puzzolana) great facilities for such constructions. This sand employed in a certain proportion with lime, makes a body, and becomes very solid.

Mines and Quarries.—The Salassi have gold mines, the working of which was facilitated by the Durias (Doria) which supplied the water required for the washings; so that, by diverting the courses by numerous branches, they often dried up the main bed, which was the cause of constant war with the neighboring people, whose agriculture was affected. The Salassi, although conquered by the Romans and dispossessed of their mines, being masters of the mountains, continued to sell water to the mine contractors.

Polybius relates that in his time among the Taurisci Norici (people of Corinthia, Istria, etc.) were mines of gold so rich that by digging the ground only two feet deep gold was met with, and that the ordinary works were not more than fifteen feet deep; that a part was native gold, in grains the size of a bean or a lupine, which in the fire only diminished an eighth, and that the remainder, although requiring to be more purified still, gave a considerable product. [He adds] that the Italians having entered into agreements with the barbarians for working these mines, in the space of two months the price of gold fell throughout Italy a third, and that the Taurisci having perceived it, turned out their foreign colleagues, and sold the metal themselves. At the present day the Romans possess these mines. The rivers, also, like those of Iberia, contain grains of gold, although in smaller quantity.

Near Acyleia (Aquileia) are mines of gold and iron easy to work.

Cisalpine Gaul has mines which are not worked so much as they used to be, perhaps because they produce less than those of the Transalpine Celts and of Iberia, but formerly they were worked very much, since a mine of gold was wrought even in the territory of Vercelli.

In the territory of Poplonium (Capo di Campana) are some abandoned mines, and the forges in which is wrought the iron of Elba, which, as it can only be reduced in the furnaces, is transported to the continent, as soon as it is brought out of the mine. Strabo says that the excavation of these mines grew up.

Pithecusa (Procida) has gold mines.

Near Luna, in Tyrrhenia, are the quarries of marble, white, and spotted with green, of which tables and columns are made of a single block. These quarries are so numerous and so well supplied, that they are sufficient for most of the fine works which are made at Rome and throughout Italy.

The Pisan territory has an abundance of marbles.

Gabii near Palestrina is in the midst of the quarries most used by the Romans.

At Tibura (Tivoli) are quarries of those different kinds of stones known under the names of Tiburtines, Gabians, red stones, of which most of the Roman buildings are constructed.

UNWILLINGNESS OF MAN TO INVESTIGATE, AND HIS WILLINGNESS TO COPY.—*By* OLIVER BYRNE, *Professor of Mathematics, College for Civil Engineers, London.*

It is difficult to make men think for themselves; most of us would rather take what we hear for granted than be troubled with the investigation, when our private ends are not concerned: and against that again, we find men opposing the most reasonable, and upholding the most absurd doctrines to support a party, to fill their purses, to gratify a pride, in order to be thought singular, or to astonish, that it may please the mass of mankind, for they are fond of the wonderful.

Again, in things that are really useful, "some are too indolent to read any thing till its reputation is established; others too envious to promote that fame which gives them pain by increase. What is new is opposed because most are unwilling to be taught; what is known is rejected, because it is not sufficiently considered that men more frequently require to be reminded than informed." This article is written to show the willingness of man to copy, and his unwillingness to investigate: and nothing can show this more clearly than the errors which are promulgated and transmitted from age to age by those who are called "learned." In a mathematical investigation, an investigation in which the mathematician is willing to occupy the most unfavorable position, he requires from you the exercise of no prejudice in his favor; but, on the contrary, would invite you to indulge in the most scrupulous frame of mind, to use the utmost penetration to discover a flaw, aye, to put the whole of your mind in opposition to him, and yet in spite of all your opposition, he will engage to convince you of the truths he proposes to establish.

In this science, the sanctuary and strong hold of absolute certainty, which claims exception from the infirmities that are attached to all other branches of human knowledge, and although what we thus establish is real truth, subject to no abatement—no modification—depending upon no hypothesis of man,—upon the authority of no great name,—mathematical truths will be the same one thousand years hence as they are at the present day, standing immutable amidst all the changes of systems and the fluctuations of opinion.

And yet, either from (as I have before mentioned,) an unwillingness to investigate, or from an inclination to copy, we find oversights, mistakes, logical absurdities, and errors, of the numerous investigators and copiers. We shall here give a few instances:—Simpson, the great mathematician, in his Elements of Geometry, which work passed through eight editions and was translated into almost all the languages of Europe, and must have been read by thousands for upwards of eighty years, we find the following erroneous proposition:—

"Two triangles that have two sides of the one proportional to two sides after other, and an angle in one, equal to an angle in the other, opposite homologous sides, are similar."

Sir David Brewster, in his translation of Legendre's Geometry, falls into a notable error, insomuch that he makes assertions which are not at all true. In speaking of Legendre, he says, "the author has provided for the application of proportion to incommensurable quantities, and demonstrated every case as it occured, by means of *the reductiod a absurdum.*"

Professor Leslie's Elements of Geometry is remarkable for false demonstrations; and in his fifth book he demonstrates the propositions or proportion to be true, when the magnitudes are commensurate. The fact that those demonstrations do not hold good when the magnitudes are incommensurable seems well known to Mr. Leslie; but that those magnitudes should also be homogeneous is altogether neglected by him.

Bonnycastle, in two of the principal propositions of his fifth book, gives demonstrations undoubtedly intended for general ones, which only apply to cases where all the magnitudes are of the same kind. That those demonstrations were intended for general ones there can be no doubt, for in his notes, page 257, Bonnycastle finds fault with Euclid's method of composition and division of ratios, as not being sufficiently general respecting these points,

Dr. Austin, in his "Examination of Euclid," commits the same error as Mr. Keith, who being desirous of applying a new demonstration to Proposition XVII, of his edition of Euclid, he employs alternation to quantities whose antecedents might be heterogeneous.

Professor Young, of Belfast, who so ably criticised many of our modern writers on Geometry, in cultivating the ideas of M. da Cunha, on the doctrine of ratios, falls, himself, if not into an error, into a great inconsistancy—that of discarding Euclid's doctrine of ratics from his fifth book. He undoubtedly treats geometrical proportion without using the term "ratio," but he gives other terms of a more lengthened nature, which precisely convey the same meaning. Now to do away with the term "ratio" here, is to do away with it in every subject that follows, or through a whole course of mathematics, and any such attempt should not be entertained, for it is not so very difficult to define what is intended to be expressed by the term "ratio." It is a different thing to have a clear conception of what the technical term "ratio" is meant to convey, from knowing that what is intended by the term cannot be expressed in many cases by numbers.

Babbage, in speaking of his table of logarithms, says, the proofs of the present tables were read three times: 1st, with the marked copy of Callet's logarithms; secondly, with a copy of Hutton's logarithms, fourth edition. 1804; thirdly, with a copy of Vegar's logarithms, folio, 1794. They were now received from the printer, and were again compared with the logarithms of Vega; fifthly, they were read with those of the Trigonometria Artificialis of Briggs.

They were next returned to the printer and stereotyped, and the proofs from the plates were read; sixthly, with the logarithms of Vega; seventhly, with the whole of the logarithms of Gardiner; eightly, with the logarithms of Taylor, and, ninthly, by a different set of readers, they were again read with the logarithms of Taylor.

After all this care and investigation, I found an error in Mr. Babbage's work not long since.

Bowditch copies the oversights of La Place. Most of our English mathematical works are translations from the French; and in the higher branches, Lardner and others not only copy the works, but also their errors, and in many cases, typographical ones.

The 17th lemma of Newton's Principia, edit. 1713, is wrong.

In conclusion, I will ask those who are willing to investigate, where did Tredgold get the number 449, so often used by him in his work on the steam engine, etc.? See Woodhouse's edition, page 84, where it is first introduced.

[From the Miners' Journal.]

OPENING OF THE POTTSVILLE AND PHILADELPHIA RAILROAD.

The 1st day of January, 1842, will long be remembered in the Coal Region; in fact, it never will, never can, be forgotten. The chronology of our region will take that auspicious day as a mark—a guide for every occurrence, great or small, that has taken place prior to it, and for all the sayings and doings that will take place in future. Although in mid winter, the day was bright, balmy, beautiful! The sun shone forth in all its glory, majesty and splendor. Its genial rays were felt and seen everywhere. The snow melted under its warm, dissolving touch. Our noble hills and mountains, but the day before covered with a white, glittering, sparkling dress of virgin snow, looked like pieces of patchwork, with spots of snow and the still green ground peeping forth in all directions, like pearls and emeralds, and not unlike soap suds on the green velvet sward.

We said it was a bright, balmy, beautiful day! We fervently trust that it was an omen of better times. At an early hour, our bustling town assumed a still more bustling appearance than usual. The old and young were abroad, with smiling faces, light hearts, and thick breeches. The "teetotallers" were abroad, too, a well dressed, happy looking set of noble fellows, strong in numbers and strong in their resolution to abjure the beastly habit of intoxication. Our different bands of music were also abroad, making the air vocal with strains of martial and soul-stiring music. Most of the ladies were at home, their beautiful faces wreathed in smiles, receiving their annual visitors with that open, kind hearted hospitality, for which the gentler sex of our region have ever been so remarkable. The public places of worship were not neglected; and many were assembled in them, to render homage and thanks to the Great Disposer of all events, for the blessings vouchsafed to them during the past year.

It was a day of joyous anticipation. The road which connects Pottsville with Philadelphia was to be opened on that day, and a locomotive, with the president, directors and officers of the railroad company, were hourly expected to arrive at the depot, below our borough. About noon, the whole town was thrown into a state of high excitement. The locomotive was in sight! The thin white vapor, as it escaped from the locomotive, could be seen hovering in the gorge of the South mountain, and the hurried panting of the *escape* announced the approach of the locomotive long before it was in sight. The directors, etc., on their arrival, proceeded to the Mount Carbon House, where they were surrounded and welcomed by numbers of the citizens of Pottsville. A hasty repast having been prepared, the company adjourned to the dining room, and all were as happy and as joyous as good feeling, good wine, and agreeable anticipations could make them. Mr. Edwards, in behalf of the president and directors of the railroad company, announced that they would partake of the preferred hospitalities of the region on Tuesday next, at the same time inviting our citizens to pay a visit to Philadelphia *en masse*, over their road, free, gratis, and for nothing, on the coming Monday. The annunciation and invitation were received with great applause. In the meantime, hundreds of our citizens, preceded by a band of music, had assembled at the depot, gazing with wonder and pleasure on the first locomotive that had penetrated into the fastnesses of the Coal Region.

The directors made but a short sourjourn, as it was necessary for them to be in Philadelphia early in the evening. By two o'clock they were all seated in the car, and in a few minutes the signal was given, and the locomotive darted away with the greatest rapidity, amid the waving of hats and the tallest kind of huzzaing. They left the depot precisely at ten minutes past two o'clock, P. M., for Philadelphia, and arrived at Peter's Island Bridge ten minutes before eight o'clock. Total time, including stoppages, five hours and forty minutes. Total running time, four hours and forty-eight minutes. This is a great performance, considering the state of the road.

Efforts to Divert Trade from New York.—In connection with the recent completion of the Great Western railroad to Boston, it may not be uninteresting to our citizens to be informed of the projects in contemplation by our Canadian neighbours, and the people on the upper lakes, to open a route for western trade, from Lake Erie to the Ocean, by way of Montreal and Quebec. A writer in the Toledo Blade, furnishes some important information on the subject. The great works undertaken by Canada, are expected to be completed in about three or four years. The Welland canal will enter Lake Erie some 45 miles above Buffalo, and the writer argues that it will be nearly as cheap to land goods brought up through it, at Cleveland and Toledo as at Buffalo. The locks now building on the St Lawrence portion of these works, are 200 feet long and 45 broad, with 9 feet water on their mitre sill. The recommendation of the chief engineer, that all the locks from Montreal to Lake Erie, should be of the same dimensions, is understood to be adopted, and this, he says, will enable large steamers and sailing vessels of 300 tons to pass through from the Lakes to the Ocean. The number of miles of canal, lake and river navigation, the number of locks and feet of lockage, from Port Colborne, at the head of the Welland canal, on Lake Erie, to Quebec is as follows: Canal navigation, 60½; river do., 526½; number of locks, 63; feet of lockage, 517.

When the Welland canal is finished to the mouth of Grand River, it will be 140 miles long, thus extending canal navigation from the upper lakes to Quebec, 72 miles, and shortening lake navigation about 20 miles. The writer alluded to, goes on to say:

"The distance from our harbor to Montreal will be about 600 miles—being a little less than to Albany. The route to Montreal will have but 72 miles on which tolls will be paid;—that to Albany has 363 miles by way of Buffalo, and upwards of 200 by way of Oswego. To Montreal there will be no transhipment—to Albany there must be one. The distance to Quebec and New York, from the ports of the upper lakes will be about the same. To the former, there need be no transhipment—no breaking of bulk; to the latter, there is commonly two, one at Buffalo or Oswego, and one at Albany. To Quebec we can go in wooden steamers of 500 tons—or in iron steamers of 800 tons; to New York, we must, a great part of the way, use canal boats, carrying about 40 tons. If sail vessels should be used at Quebec, they may be constructed to carry 300 tons, and they may be towed up and down the St. Lawrence from Ogdensburg, say 270 miles, by a steam tug, as cheap at least, as canal boats can be drawn on the 40-foot-wide Erie Canal."

Freight Business on the Norwich and Worcester Railroad.—But few of our readers are aware of the quanity and value of the merchandise and produce that pass weekly over this road. Upon inquiry, we learn that from the 1st of January last to this date, the receipts from freight alone *average* something more than $1,000 per week; and for the last eight months, $1,150 per week.

We understand that it is intended to arrange a line of packets for the next season, and start one every day for Norwich and New York. Also, to place upon the route to New York one or more steam freight boats. By these arrangements, and suitable efforts, it is believed that this branch of business will amount to $1,500 per week, or $75,000 for the year 1842,—a sum more than sufficient to pay all the expenses of the road.—*Norwich Courier.*

A Profitable Railroad.—A memorial to the Legislature of New York states that the nett profits of the Utica and Schenectady railroad for the last five years have been $238,887 per annum on an average, or 13¼ per cent. per annum on the capital, and praying the Legislature to restrict the rate of fare to two cents per mile.

Dividends.—The Auburn and Rochester railroad company has declared a dividend of nine per cent., payable 1st of January, to stockholders on the books in this city, at the Bank of the State of New York. The road has been completed only about three months.

Iron Manufacture in Pennsylvania.—Such statistics as the following, which show the magnitude of the resources of our widely extended country, are well worthy of record. They are copied from the concluding passages of an article on the iron manufactures of Pennsylvania which appears in the Harrisburg Intellegencer:

Productions of iron.	Tons of pig iron.	
210 charcoal furnaces, yielding - -	98,350	
12 mineral coal, say - - -	15,000	
Total pig iron, $30 per ton, - -	113,350	$3,400,500

Manufactures of iron.

70,000 tons made into bars, additional value,		-	2,800,000
71,000 tons castings,	do.	do. -	5,000,000
65,000 tons rolled iron,	do.	do. -	3,474,979
Iron in 270 steam engines,	do.	do. -	700,000
7,017 tons nails,	do.	do. -	253,110
Scythes and sickles,	do.	do. -	15,000
Edge tools,	do.	do. -	110,000
Cutlery,	do.	do. -	25,000
Shovels, spades and forks	do.	do. -	30,000
Guns,	do.	do. -	185,074
Cars, and other vehicles,	do.	do. -	900,000
Ploughs, iron,	do.	do. -	107,000
Sheet iron manufactures,	do.	do. -	100,000
Articles made by blacksmiths,	do.	do. -	5,000,000
			$22,100,665

Thus it will be seen that the iron produced in Pennsylvania, and the additional value given to it by our mechanics, amounts annually to more than the sum of *twenty-two millions of dollars.*

There is also consumed in the manufacture more than 180,000 tons of anthracite and bituminous coal.

There are employed in the manufacture of iron in all its branches more than 20,000 workmen, so that, with their families, depending upon the iron business, we have a population in Pennsylvania of more than 120,000 persons.

Ogdensburg and Champlain Railroad.—A public meeting was held at Plattsburgh on the 8th inst., at which, among other things, it was resolved that the construction of a railroad from Ogdensburg to Lake Champlain, by *the State,* "can no longer be delayed, without an abandonment of the best interests of *northern* New York," and the members of the Legislature from the 4th Senate district are requested to urge the immediate passage of a law authorizing the commencement of the work.—*New York Standard.*

TO OUR READERS.

We have received another communication on Mr. Ellet's pamphlet on the "Failure of many Railroads," etc., too late for our present number, but will appear in our next.

AMERICAN

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AND

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FUTURE PROSPECTS OF THE RAILROAD CAUSE.

The present period is one of remarkable interest in the history of railroads. While the price of stocks of all kinds is at the lowest ebb, while all kinds of investments are looked upon with suspicion, and while the money market is, technically speaking, excessively "tight," we find three of the greatest commercial cities in the Union completely immersed in the discussion of the railroad system, and that not for a few days only, but for weeks and months together.

In Boston, the rejoicings, upon opening an uninterrupted line of railroad communication with the very heart of the State of New York, have not yet died away, and self-gratulations and mutual encouragements are yet the order of the day. In the city of New York, the opening of a portion of the New York and Erie railroad has opened the sleepy eyes of our citizens to the advantages they have quietly suffered to lie unemployed or to pass into the hands of their neighbors. Stimulated by the enterprize of Boston, our citizens have determined that the New York and Erie and the New York and Albany railroads *shall* be completed. In Philadelphia, the opening of the Philadelphia and Pottsville railroad has justly been celebrated as the completion of the most important work in that State of public works. Philadelphia is now made, without doubt, the great coal mart of the Union, being but a few hours travel from the greatest deposit of anthracite in the world.

In addition to all this, the recommendations of the Heads of the War and Post Office Departments, that railroads being essential to the necessities of the Government, should be, by mutual contract, secured perpetually as transporters of the public mail and the United States troops,—have turned the attention of the whole community to this subject, and with the very few exceptions, that always must be expected, the voice of the whole nation has been heard in favor of railroads. They are demanded for the public convenience,—for the public comfort,—for the public safety.

Such being the case, it is highly necessary and proper that the discussion of the subject should not be entirely left to the popular view of the question, but receive the support and countenance of the Profession. What we most want at the present time is strictly accurate and numerical details of the cost of construction and management of roads *at present prices.* It is well known that the price of railroad iron at present is not much more than half of that paid for most of the rails now in use, and other materials as well as labor have also been lowered in price in various degrees. Correct information upon these points is therefore highly interesting, and all details will be eagerly sought for.

Engineers are, for many reasons, the persons best qualified for giving such information ; and it is not a little surprising that they have, with few exceptions, so uniformly abstained from appearing in any manner before the public or even before the profession as contributors to the general fund of information. We have so often spoken of this before, that we shall not dwell any longer upon the subject, except to remind our professional readers that what we recommend is a matter of the highest importance to their interests, and not to be neglected without detriment both to the public and themselves.

[For the American Railroad Journal and Mechanics' Magazine.]

FAILURE OF RAILWAYS.

I had, at first, only cursorily glanced through Mr. Ellet's pamphlet on this subject, and was happy to think it a panacea for all the ills of railways, but on reading the notice of it in the number of your Journal of the 1st January, I have been led to give the subject a further consideration, and agreeing mainly with that notice, I am now disposed to regard Mr. Ellet as laboring under a delusion.

Besides presenting some *self evident* matter, which sad experience in most instances has rendered only the more *palpable*, the ground taken by Mr. Ellet is, as I understand him, as follows :

That costly roads have been built where cheap ones were only want-

ed; and that the present actual amount of trade and travel in all cases, ought to have been, and must in future, be the exact measure of the solidity, and consequent outlay for both road and machinery.

In all discussions it is of all things important to start with a right understanding of terms. What is then, *at this day*, understood by a railway? I should say, there can be made only two degrees of them, the positive without, and the superlative with steam power; the latter applied to it by means of the locomotive, to which it owes all its value, and which as having most developed the two greatest elements of economy, velocity and power—is distinguished as the most remarkable invention of the age. In the progress of this machine, it was found that the heavier it could be used, its weight at the same time being more equally diffused over the rail, the more it could do and the longer it could work, with less expense for repair to itself or the road. The true economy of the railway depending thus on the *the weight of the locomotive*,* it consequently becomes the rule, as well for its own cost, as of an *adequate* structure of road to sustain it, and to crown the whole system with the indispensable element of safety.

The object of this improvement in particular, being to give at first much cheaper and better accommodation to the existing business, and afterwards to multiply and extend it—a higher standard than the old or ordinary facilities would be necessary to effect that object. Throwing the turnpike† out of view, the steamboat and the rail-

* Messrs. Eastwick and Harrison, of Philadelphia, were among the first to make these massive eight wheel engines really effective. Baldwin and Co. have recently put out one on six wheels of thirteen tons, nearly the whole adhesion being obtained from that weight, and in a recent chance occasion she drew three hundred and thirty tons over a grade of thirty-two feet, adapting herself with every facility to a curve of ninety degrees. The desideratum of having no friction without a corresponding compensation, will thus be secured, while heretofore one-third of the weight of the engine has been worse than lost, in doing injury without any return.

† To give the reader an idea of the cost of an ordinary turnpike and Macadamized road as compared with that of the railway, and he has now learnt that the two are scarcely comparable as to relative utility, we append the cost of portions of the Great National Cumberland Road as per report from its engineers. It is graded 30 feet, covered with lime stone the width of 20 feet, and to the depth of 9 inches. The cost of keeping it in repair is not much under that of a good railway:

Portion in Ohio,	average per mile,	$11,258
Do. Indiana	do.	$21,102
Do. Illinois	do.	$23,868

The whole length of the road, when completed, will be 595 miles, and the total cost between $8,000,000 and $9,000,000. The lowest cost per mile in the above averages are given at $4,400 and $6,800 per mile. This latter is about the average at present for grading a railway; and estimates for an entire road with heavy edge rail and motive power and cars, do not *now* exceed $20,000 to $25,000 per mile. In viewing the railway as an *arm of defence* alone, what a waste does the Macadamized road appear at even half the cost of the former. In this view, look at the Pottsville and Philadelphia railway, which, at its opening, threw into Philadelphia by one engine and train 2,150 miners, accompanied by another engine and train of coal, which could as well have been a park of one hundred pieces of artillery, in 6 hours, from a distance of 100 miles.

way, as we now find them, have created that standard in the public mind, and by which it would not now be satisfied with a lesser speed than twenty miles per hour with safety, and would only regard that an improvement, which possessed the power to surpass that rate, as the modern railway is in fact able to do.

The idea, however, is certainly novel, that any facility designed *to promote* the intercourse of trade and travel, should, according to Mr. Ellet, be *tied down* to a specific capacity, and limited only to the existing business, which could never be exactly ascertained,—and which naturally elastic and expansive, would require that that facility should be so too, at least in an equal, if not in a greater degree. The railway it is, that is made of this peculiar stuff; and if not, in some cases, immediately remunerating to its projectors, it has in all been sure to give amplitude and scope to the community so lucky as to possess it, and particularly if of the more modern construction.

The railway system is now undoubtedly successful as a whole; and were the secret history of such as are exceptions, to be had, it would most likely unfold other than the mere apparent causes of their early and present want of success. A report from the Winchester and Potomac railway furnishes some facts and views, which, as apropos to our subject, may be here detailed,—its career is the type of many others.

This road has been in operation for some years, running from Harper's Ferry, thirty-two miles, to Winchester, Virginia, has thirty feet grades, is a slight flat bar structure, and in the last year transported about 20,000 tons, principally flour.

It started with locomotives, then determined by its engineers as most suitable to such a road, weighing only four and a half tons, capable of drawing only nineteen to twenty tons over the above grade of thirty feet, yet with this light engine was it continually disordered, and its income almost entirely consumed annually in adjustment and repairs. The want of continuity in the road was a cause of great expense to it, in the necessity for transferring all the freight at the Ferry, by which treble and quadruple the time was taken to convey freight, etc., to and from Baltimore and Winchester, *and this time was so much capital actually lost;* the business of the two roads was also limited by the amount of freight that could be manifested and transferred at the Ferry, and was consequently fatal to any increase of revenue.

An entire revolution has now been effected in the arrangement of this road; the Ferry has been bridged, and the road made *con-*

tinuous,—the superstructure readjusted,—and in place of the four and a half ton engines, drawing only nineteen to twenty tons, they have now put on one of thirteen tons on eight wheels, capable of drawing one hundred tons and upwards, having recently delivered, in one load, at the Ferry, eleven hundred and seventy-five barrels of flour, and that over a flat bar, on which her power is at least twenty-five per cent. less than on an edge rail, thus performing the work of three or four of the lighter engines, *with even less injury to this fragile road than the lightest of them.* This was an amazing change in the economy of their affairs, and will be the more visible in the following statement:

	Cost.	Expense of running per day.	Nett freight.		
One 13 ton engine,	$8,500	$25	Load,	120	tons.
Four 4½ "	12,000	95	"	80	"
Total saving,	$3,500	$70		40	

If then to this saving in capital, daily outlay and gain in power, be added the lesser risk of disarrangement to the business of the road, and a smaller establishment being necessary for repairs of road and machinery,—the substitution of the ONE larger engine, would economise at least one hundred dollars per day, and which would be *the more important at the start with a small business*, than afterwards with a larger one. Upon this, the report remarks, (Railroad Journal, of 1st September.)

"This is but one of the results of experience in showing the necessity for increasing the power without increasing the expenditure, and diminishing the gravity or pressure of the engine, by multiplying its points of contact with the road."

"The question is now no longer how or what we shall carry, but in what manner we shall command the greatest amount of trade,—how we shall lengthen the radius and extend the circle of commerce."

In this last quotation, is indeed expressed the scope and purpose of the locomotive railway; and immediately above it, is it practically demonstrated that, as its *weight and cost* are increased, so is its economy;—and the most recent recognition of this principle is found in the adoption on the Massachusetts Western railway of Mr. Winan's nineteen ton engine,* distributed on eight driving

* "We learn with great pleasure that the twenty ton engine from Baltimore, with its whole weight on eight drivers, works admirably between Greenbush and Springfield, even on the Hudson and Berkshire (flat bar) railroad. This engine can carry a very heavy load, say one hundred tons freight over the eighty feet grade of the Western railroad."—*Boston Transcript.*

wheels. Were there no other developments of the system, this is enough of itself to overthrow Mr. Ellet's theory; one extreme of which, may be described as contemplating *a mere wooden road, to cost only one thousand dollars per mile, an engine of a half of a ton weight, a car and engine shed to cost only fifty dollars, and the whole concern to be managed by* ONE PERSON, *to unite therein the various capacities of engineer, conductor, fireman, and treasurer; and if the road be* VERY SMALL, *superintendent and general commissary;* and this thing he claims, must not be thought *too contemptible* to be called a railway. His other extreme, which contemplates a road to cost as high as thirty thousand dollars per mile, and a locomotive of twenty-five ton weight, about accords with the present progress made in this improvement; and when roads must hereafter be built, for few will now be attempted, except under a strong necessity, he will find, as we believe, that they will be required in all cases, to be built nearer this extreme, without much reference to the actual existing business to be accommodated. (See pamphlet, page 11.)

And as going to show that a substantial road at the start, and under all circumstances, is demanded by the economical principle of the weight of the locomotive, we quote from a late memorial to the Maryland Legislature, from the Elkridge and Annapolis railway, which, although far in advance of any business to support it, yet has thought it wisest to provide itself at first with the best means of creating it:

"Your memorialists would refer your honorable body to its memorial to the General Assembly, at the last session thereof, for a more detailed explanation of the causes of this excess of expenditure, and especially of the reasons which influenced your memorialists to adopt a heavy edge rail, forming a permanent road, in the stead of the one *which had been found by experience to be wholly inefficient.*"

As a general rule a good article *at first* is cheapest in *the end*, and least of all is the railway an exception to this rule; it had better, therefore, be never attempted, except when it can be afforded *good and costly*, as then only is it enabled to evolve all its great effects; and that it does not admit of the graduated scale to which Mr. Ellet would subject it, is further evident *in the necessity* for the same *speed and safety*, whether you have one or a thousand passengers to transport.

Discussion promotes inquiry,—and as this is a subject on which the public mind is still much entangled, every attempt at unravelling it, however feeble, should be thankfully received.

X.

PHILADELPHIA AND POTTSVILLE RAILWAY.

On the 10th of January, a formal opening of the road between Pottsville and Philadelphia took place, which was made the occasion for a joyful celebration, by a dinner at Philadelphia and a ball at Pottsville. It gave some earnest of its immense powers and future utility, by delivering at Philadelphia 2,150 passengers in 76 cars, forming a train 1,255 feet long, drawn by one engine, the "Hitchens and Harrison," accompanied by another train of 180 tons of coal, also drawn by one engine. The weather was unpropitious, snow having fallen during the early part of the morning to the depth of several inches.

In the evening of the 10th, after a pleasurable day, a large company sat down to a supper at the Washington House, Philadelphia. On which occasion, after some introductory remarks, Mr. George W. Farquhar, of Schuylkill county, made the following remarks:

The turnpike and the canal, it is true, have already given to our products an access to the great emporium of Pennsylvania, but the magnificent work, the consumation of which we now celebrate, places us in a more intimate relation, and for the advantages of pleasure, information and business, has made us almost a suburb of our parent city. If any thing could strengthen the ties of kindred interest, and of filial affection which bind us to Philadelphia, it is this noble achievement which has been so successfully accomplished. The patriotism and foresight manifested in the conception of this great improvement, the skill which directed it, and the sagacious liberality by which it has been fostered, command alike our admiration and regard. When we reflect upon the multiplied difficulties that have been encountered; when we consider the great natural obstacles that have been surmounted, that the stream has been arched, the valley filled up, and the rocky base of the mountain swept aside—we are compelled to concede enterprize, energy and ability of the highest order to those who have accomplished this most invaluable improvement. But they have done more. They have moved steadily forward, dispelling prejudices, and triumphing over conflicting interests, at a period when public enterprize and individual efforts were sinking under the crushing embarrassments of the times. During this most appalling crisis, when confidence was lost at home, and credit blasted abroad; when common bankruptcy seemed likely to involve not only the citizens, but the States themselves; when your General Government was a petitioner in Europe for a loan of a few millions, and had its petition rejected; when so prostrated were our resources, that dispair suggested the dis-honest expedient, that though it might be difficult to pay, it was easy to repudiate. Still with a generous confidence in their own resources, through evil report and good report, they have pressed on, conscious that they were bestowing an inestimable benefit upon the community, and that the reward would be commensurate with the struggle. They have victoriously accomplished this glorious adventure—productive of immediate, and pregnant with future advantages. This great work is finished. It stands a monument of the wisdom that conceived, the genius that planned, the energy that sustained, and the mechanical skill that executed it—the model railroad of the day. We gratefully acknowledge the incalculable advantages that the Coal Region will derive from this new avenue to market, and while we admit our own peculiar obligations, we assign, and we believe posterity will assign to the Philadelphia and Reading railroad company a high place among the benefactors of the State. We extend to them the right hand of fellowship, hoping that the connection which they have this day established, may be as beneficial to them as it is advantageous to us.

If it be true that the internal communications of a country are a fair test of its resources and of its progress in cultivation, does not our own State occupy a most enviable position? On the eastern side of the Alleghany, our waters are every where tributary to canals and our railroads pervade the country in all directions. In these improvements we are in advance of the age; but our self-congratulation may be checked by the reflection, that in making them we have incurred an enormous debt. True it is we have been lavish, prodigal, perhaps corrupt, in our expenditures, but are we bankrupt? Let our iron, producing some $22,000,000, and our coal between 4 and 5,000,000; and our agriculture at least double the amount of both the mineral staples, answer the question—as well might a debtor display a well filled purse and refuse on the plea of inability to pay a trifling demand, as for Pennsylvania to point to her mountains of coal and iron, her work shops, and her harvest fields, her canals and her railroads, and talk of insolvency.—Besides we are not to consider our State debt as money lost. It has already greatly benefitted and will continue to benefit the country. Revert to the towns on the Susquehanna some ten years since, and view them now? Their improvement is so great as almost to raise a doubt as to their identity.

Observe the increase in the value of land. Turn to your census, and regard your population growing at a ratio greater than that of any of the old States, not excepting New York, which has also an extended system of improvement. Our debt has been enlarged, it is true, enormously, but our prosperity has advanced still more rapidly,—and the prosperity has been mainly caused by our railroads and canals. Is it, however, a mere question of dollars and cents? Is the benefit to be estimated only by the money expended and the money to be received?

Independent of their business value, those improvements are a strong bond of union among our citizens,—facilitating intercourse,—they bring us together,—ideas are enterchanged and an increased degree of intelligence and refinement is diffused. If the question were submitted, to retain Pennsylvania as she now is, with all her debt, and with all the advantages accruing from it; and to retrograde to what she was, and what she would now be without her improvements, can any patriot hesitate as to the answer? No one, who has examined the statistics of our State can doubt that her resources, properly husbanded, are sufficient to meet her engagements. If they cannot be liquidated by the ordinary resource, let us resort to direct taxation fairly and honestly proportioned.

Schuylkill county, though sustained by improvements to which the State debt has contributed nothing, will cheerfully bear her quota. We cling fast to the honor of Pennsylvania—we will pledge our mines, our canals and our railroads to preserve it—we will submit to any burden, but the infamy of repudiation.

We must view this railroad as the first link in a connected chain of improvements. When the communication is extended to the Susquehanna, it will intercept a large trade which now descends to the Chesapeake. In conjunction with the contemplated improvements to Lake Erie, it will command a fair proportion of the immense inland business which is now enriching New York. I feel gratified that the railroad cannot be tapped, and that the anthracite coal and iron of this region will find at least a primary market in Philadelphia. It is then emphatically a Pennsylvania work, promoting Pennsylvania interest, and transporting her mineral treasures to her own metropolis. We must bear in mind also that the commodities to be transported are of unquestionable value and of indispensable use—not articles of luxury or even of mere convenience, but those which a judicious policy requires to be supplied as abundantly and as cheaply as possible. Let it be remembered that the great ascendancy of Britain is owing to her coal and iron, and that deprived of them, her manufactures would cease, her trade would perish, and she herself sink into a subordinate grade among the nations. This new avenue will increase the supply and of course diminish the price of that metal, of such universal application that society would be helpless without it. That metal which either as a tool fabricator, or as a component part, is fabricated to minister to all our wants, without which the soldier would be harmless, the farmer useless, and the steam power itself, but an ingenious contrivance incapable of extended practical benefit. The completion of this road will hasten the day when Schuylkill county shall pour her anthracite iron from her numerous furnaces to increase our domestic comforts, and protect us from foreign aggression. This alone would connect this work with our dearest interests. But the more immediate business of the road will be the transportation of coal. It is not our purpose here to enter into the vexed question as to the relative advantages of canal and railroad. We hope and believe that our business will increase with the facilities afforded, and that with the aid of a judicious tariff we should give sufficient occupation for both. It is sufficient here to say that the weight of authority supports the position, that a railroad transacting a general transportation can at least successfully compete with a canal. The mass of our citizens may be indifferent whether the more profitable business be effected by the one or the other route, but the benevolent mind must be interested in the fact, that the existence of this road ensures an abundant supply of fuel at all periods, and as a consequence, at a fixed and reasonable rate. There can be neither a scarcity, nor much fluctuation in price. During the inclement season, when our ice-bound waters exclude the transportation of coal or wood on boats, the railroad will continue its regular supply. The poor man's hearth and the widow's stove will be replenished at an easy rate, and the almost proverbial phrase, "a hard winter for the poor," will lose a part at least of its painful significance.

The certainty of the supply at a price subject to little variation will greatly enlarge the consumption of coal. There are a multitude of furnaces in which wood is now exclusively used; because those interested in them are unwilling to make expensive alterations to adapt them to coal, and then be exposed to the inconvenience of a limited supply, and a varying or speculative price. When it is once ascertained that the quantity will at all times equal the demand, our anthracite in the work-shop, and in the steam boat, will supersede all other fuel. I am then justified in asserting that the necessary tendency of this most interesting improvement is to diminish the suffering of the poor and largely to diffuse and increase the consumption of our mineral staples.

Mr. Chairman: I have trespassed too long upon your attention; I have been led away from my point; and return to it with a toast.

The Philadelphia and Pottsville railroad company:—They have won their way into the heart of the coal region, and in its heart shall they be cherished.—*Abridged from the Miners' Journal.*

CHEAP FUEL.

In contemplating the effects of the recent connection, by railway, of the Pottsville coal mines with tide-water at Philadelphia, the great element of social comfort and economy, cheap and abundant fuel, presents itself in pleasing relief to our view.

From the main body of the coal fields, the principal canal down the Schuylkill, has been able to dictate the toll—and the freighters, an independent interest, have always preyed on all other interests concerned, by taking advantage of every contingency to make what terms they pleased; it was no uncommon thing, therefore, for the freight on that canal to begin in March at 85 to 90 cents per ton, and with the progress of the season to rise to $2 50 per ton: a certain calculation as to cost, was accordingly out of the question.

Under the coming influence and control of the railway, how completely will simplicity, economy, dispatch and certainty, be secured to the trade. Let us compare only the main items: in all minor ones the railway has much the advantage.

As heretofore conducted on the Schuylkill canal, the toll paid in cash at the start, has been 90 cents per ton, and an average freight on delivery, of $1 25, but in future the toll may be put at - - -	50	
The freight do. - - - -	90	
	——	$1 40
Cost of the coal at the mouth of the mine paid in cash		1
Active cash capital required for a ton of coal, dealing by canal, which can only be turned once in two weeks on the average - - - - - -		$2 40
Hereafter, by the railway, the toll and freight will be paid in *one item*, where the car belongs to the dealer, at - - - - - - - -		$1 30
Cost of the coal at the mine in cash - - -		1
		$2 30

In the case of the railway, however, but ONE DOLLAR ACTIVE CAPITAL is required to pay for the coal at the mine, as a credit for the freight of at least a fortnight can be had by the railway, during which time the dealer can realize the whole cost of the coal including his profit four or five times, to once by the canal; and in this accommodation, the railway is perfectly safe, in having control of the dealer's car, and most generally possession of a portion of his coal on deposit. There is no hold or facility of this sort by the canal.

In looking at this one feature alone, can any one doubt that the railway must get all the trade it will accommodate; and with the attraction of interest thus powerful, it cannot be long before the public, not of Philadelphia alone, but that of the whole eastern seaboard, will be unanimous in carrying this improvement, which has involved so many sacrifices, to its utmost limit of utility. Every development can only give a keener edge to this impulse of interest.

The canals are evidently expecting such a result, and are preparing for a sharp contest, determined to maintain the superiority they have so long claimed as the cheapest carriers, especially in this article of coal.

The following are about the relative costs, delivered afloat in New York, by each of the avenues, which are to enter the list in the grand tournament to come off in the ensuing season, or after the middle of March, 1842, for the amusement and benefit of coal consumers;

Schuylkill railway:

Cost at mine - - -		$1	
Toll on lateral road - -	25		
Toll on main road to Delaware	1 50		
	——	1 75	
Freight in 200 ton barges through the Delaware and Raritan canal		85	
		——	$3 60 per ton.

Schuylkill canal:

Cost at Schuylkill Haven - -	1 50	
Freight through to New York, including towage and toll to Delaware and Raritan canal - - - -	2 35	
Toll to Schuylkill canal - - -	45	
	——	$4 30 "

Shipped by sea from Philadelphia, about the same.

Lehigh canal:

Cost at mouth of Morris canal at Easton	2 50	
Freight per Morris canal, supposing it enlarged for 50 ton boats - -	1	
Toll at half a cent per ton per mile -	50	
	——	$4 00 per ton.

Shipped by way of Bristol, about 25 cents higher per ton.

Lackawanna canal:

Coal delivered at Honesdale - -	1 40	
Freight to Rondout - - -	1 37	
Toll - - - - - -	40	
	3 17	
Freight, etc., to New York - -	53	
	——	$3 70 "

In giving the above as the relative pretensions to strength of the parties, they must be understood as being bared to the skin, and no profit allowed in either case, except to the railway as a carrier. The latter entering as a new and modest knight, rather to give variety to the contest and to fill up the lists, will expect from the public, to whom the prize will belong, a liberal assistance in its preparation for a fight, *thought by many to be altogether so unequal.*

[From the Civil Engineer and Architect's Journal.]

ON THE MOMENTUM PROPOSED BY MR. JOSIAH PARKES, AS A MEASURE OF THE MECHANICAL EFFECT OF LOCOMOTIVE ENGINES. *By the* COUNT DE PAMBOUR.

In the *Transactions of the Institution of Civil Engineers*, Vol. III, Mr. J. Parkes has published a paper *on steam boilers and steam engines*, in which the object is to propose, as a new measure of the mechanical effect of locomotive engines, what he calls the *momentum* produced by the engine, that is to say, the product of the mass, in tons, of the engine, tender and train, multiplied into its velocity, in feet per second. According to him, this momentum being measured at one velocity, for a given engine, the effect of the same engine, at any other velocity, will be immediately deduced from it by a single proportion (page 130,) without troubling one's head about the inclination of the road, the friction of the wagons or the engine, the counter-pressure due to the blast-pipe, the resistance of the air, or, in fact, any of the resistances really encountered by the engines.

To establish this new idea, Mr. Parkes's first step is to represent as altogether faulty and impossible every calculation or experiment made by others, to take account of the divers resistances offered to the motion of the engines. With this view he enters into a long and malevolent discussion on the experiments of our *Treatise on*

Locomotive Engines, and on all the experiments on the same subject published by different engineers; and to demonstrate the difficulties insurmountable, in his opinion (page 124, 129,) and the uncertainty attending such researches, he indicates several verifications which, as he says, these experiments ought to satisfy, and which they do not satisfy. As Mr. Parkes gives on the subject a great number of arithmetical calculations, the errors of which are protected against detection by the heap of figures presented, we shall first enter, with some detail, into the examination of his pretended verifications, and afterwards shall discuss the value of the new measure proposed by him to represent the mechanical effect of locomotive engines.

On seeing the *fundamental* errors on which his reasoning and his calculations are grounded, the inaccuracy of his criticisms and of the results at which he has arrived, will be at once recognised.

1st. Mr Parkes proposes to calculate the pressure at which the steam was necessarily expended on the cylinder of each engine snbmitted to experiment, in order afterwards to compare that pressure with the pressure resulting from the sum of the different determinations of resistances exerted against the piston, according to the *Treatise on Locomotive Engines.* With this view, he seeks, from the velocity of the engine, the number of cylinders full of steam which were expended per minute. Comparing the volume thus obtained to the volume of water vaporized in the boiler, he concludes the *relative* volume of the steam during its passage into the cylinder; and finally, recurring to the table of the relative volumes of steam under divers pressures, contained in our *Theory of the Steam Engine*, he concludes the pressure which the steam must necessarily have had (page 82, etc.) This is conformable to our theory developed in the *Treatise on Locomotive Engines*, which, in fact, Mr. Parkes entirely adopts. But to perform this calculation, Mr. Parkes takes the *average* velocity of the whole trip from Liverpool to Manchester (page 85, and table viii., col. 10; table xiii., col. 9; table xvi., col. 2, etc.,) and from that velocity he pretends to deduce the *mean pressure* of the steam in the cylinder during the same trip. Now it will be easy to prove by an example that this mode is altogether faulty.

Suppose, in effect, the engine Atlas has travelled a distance of 30 miles in an hour and a half, vaporizing 60 cubic feet of water per hour. As the wheel of the engine is 5 feet in diameter, or 15·71 in circumference, as there are two double cylinders full of steam expended at every turn of the wheel, and as the capacity of those two double cylinders, including the filling up of the steam ways, amounts to 4·398 cubic feet, it follows that the volume of the steam which passes into the cylinders per mile performed, or per distance of 5280 feet, is $\frac{5280}{15{\cdot}71} \times 4{\cdot}398 = 1478$ cubic feet.

This premised, when Mr. Parkes refers to the average velocity of the whole trip, to value the pressure in the cylinder, as that velocity is 20 miles per hour, and as the vaporization at the same time is 60 cubic feet of water per hour, he finds, for the ratio of the volume of the steam expended to the volume of water, $\frac{1478 \times 20}{60} = 492{\cdot}7$. Consequently, recurring to the table of the relative volumes of steam under different pressures, he obtains for the corresponding total or absolute pressure 56·66 lb. per square inch; and deducting the atmospheric pressure, he obtains for the effective pressure, 41·95 lb. per square inch.

But to show that this mode of calculating, from the average velocity, can only lead to error, let us suppose that, by reason of the divers inclinations of the portions of the railway, the first 15 miles have been traversed in half an hour, and the other 15 miles in an hour, which still makes 30 miles in an hour and a half; as 30 cubic feet of water will have been vaporized in the first half hour, or during the passage of the first 15 miles, and 60 cubic feet of water during the next hour, or in the passage of the last 15 miles, it is plain that the volume of the steam will have been respectively in each of those times $\frac{1478 \times 15}{30} = 739$ first, and afterwards $\frac{1478 \times 15}{60} = 369·5$. Whence results, according to the table, that the effective pressure of the steam will have been successively 21·62 and 62·95 lb. per square inch.

Thus, during the first half hour the effective pressure will have been 21·62 lb.; during the second half hour it will have been 62·95 lb., and during the third again 62·95 lb. Consequently, taking account of the time during which the pressure has had these respective values, it is plain that the mean effective pressure in the cylinder will really have been $\frac{21·62 + 62·95 + 62·95}{3} = 49.17$ lb. per square inch, and not 41·95 lb. per square inch, as given in Mr. Parkes's calculation; which, by the fact, supposes all the portions of the trip to have been performed in equal times. In this case, therefore, which has nothing in it but what is very ordinary, there would be an error of 7·22 lb. per square inch out of 41·95; that is an error of more than $\frac{1}{6}$ on the effective pressure of the steam. It is evident that the calculations, such as Mr. Parkes makes it, is exact only for portions of road composed of one inclination, or travelled with *uniform* velocity, and that it cannot apply to the total passage of a line composed of different inclinations. For further elucidation on this head, we refer to chapter XVII., relative to inclined planes, of our *Treatise on Locomotive Engines*, second edition, and to chapter XII. of the same work, in which all the experiments considered by Mr. Parkes are calculated.

2nd. We have just shown the first error which Mr. Parkes introduces, as a fundamental basis, in his calculation of the pressure of the steam in the cylinder. But he does not stop there. In the table of experiments on the vaporization of the engines (*Treatise on Locomotive Engines*, page 175 of first edition, and page 253 of second edition,) we have given the average velocity of the engines during each trip; and that velocity is obtained simply by dividing the whole distance performed, by the time employed in performing it, as is seen in the table in question. It would be natural then for Mr. Parkes, who, as has been said, is satisfied with average velocities in his calculations, to take those which are given in the table; but instead of that, he augments almost all the velocities about $\frac{1}{5}$. Thus, for instance, the Vulcan, which travelled 29·5 miles in 1 hour 17 minutes, and whose average velocity in consequence was stated to be 22·99 miles per hour, had, according to Mr. Parkes, a velocity of 23·90 miles per hour. The velocity of the Vesta rises from 27·23 to 31·60 miles per hour, and so of the others (table viii., col. 10; table xiii., col. 9; table xvi., col. 2.) The critic falls into this new error because, in the *Treatise on Locomotive Engines* (page 324 first edition, and page 311 second edition,) in speaking of fuel, it is said that, when the engines ascend without help the inclined planes of the Liverpool and Manchester railway, the surplus of work, thence resulting for them, equals, on an average, the conveying of their load to $\frac{1}{6}$ more distance, and Mr. Parkes logically concludes from this that the *velocity* of the engine must be by so much increased (pages 86, 112.) So that if an engine perform 1 mile in 4 minutes, ascending a plane inclined $\frac{1}{89}$, which renders nearly five-fold the work of the engine, it would follow, from this calculation, that the velocity would not have been 15 miles per hour, but $15\times5=75$ miles per hour, since the quantity of work done would have been five-fold! Mr. Parkes's error proceeds from his having applied to the velocity a correction which refers only to the *work* done, and, as a consequence, to the corresponding consumption of *fuel*.

But on examining what effect results from this substitution of the imagined velocity of Mr. Parkes for the observed velocity, it will be remarked that whenever an engine is obliged to ascend without help one of the inclined plains of the Liverpool and Manchester railway, it exerts at that moment, as we have said, an effort five times as great as upon a level, and draws its load less rapidly. One would deem it then allowable to conclude, that the average pressure of the steam in the cylinder must be augmented, since during a certain portion of the trip, the effort required is greater, and that the *useful* effect per unit of time must be diminished, since during the same time the useful load is drawn at less velocity. But no. Mr. Parkes's calculation, by augmenting then, the apparent velocity of the engine, demonstrates that, in this case, the average pressure in the cylinder becomes on the contrary much *less*, and that the useful effect becomes much *greater*. So that the error committed produces itself here in the two opposite ways.

With these elements, Mr. Parkes establishes the *whole* of his calculations and tables, to the very end of his paper (table viii., col. 10; table ix., col. 19; table xiii., col. 9; table xiv., col. 2; table xvi., col. 2;) and as, to augment the evil, this pretended correction is made only on one portion of the experiments, namely those in which the engines were helped up the inclined planes, without being made in the other cases there results an inexplicable confusion in all the calculations. Thus, it happens that Mr. Parkes's determination of the volume and pressure of the steam consumed by the engines (table ix., col. 26, 29,) the horse power produced per cubic foot of water vaporized, or the quantity of water employed to produce one horse power (table x., col. 44, 45, 49, etc.,) the momentum generated per pound (table xiii., col. 11, 12; table xiv., col. 9, 10, 11,) and all the consequences thence derived are in every way erroneous.

To show by a particular example, the fallacy of the results to which Mr. Parkes has been led by this wholesale and faulty way of calculating, we need only refer to the two experiments of the Fury, which he extracts from our work on locomotive engines. He pronounces, "with certainty," (page 128,) these two experiment to be erroneous, as exhibiting an engine performing more work at 23 than at $21\frac{3}{4}$ miles per hour, in the ratio of 24 to 19. Now, to arrive at this conclusion, Mr. Parkes first takes the velocity of the engine, not at 18·63 and 19·67 miles per hour, as given from actual observation, page 175 of the first edition, and pages 253 and 392 of the second edition of our Treatise on Locomotive Engines, but at 21·79 and 23 miles per hour (table xiii., col. 3.) Secondly, in comparing the work done in the two trips, he does not take into account that the first of the two trips has been made from Manchester to Liverpool, and the second on the contrary from Liverpool to Manchester. But there is a general rise of the ground from Manchester towards Liverpool, and from that circumstance, the gravity opposes more resistance in that direction than in the contrary one. Thus it happens that a less train carried on the line from Manchester to Liverpool, may require from the engine, a greater quantity of labor than a heavier train carried in the opposite way. In effect, by referring to pages 501 and 504 of the second edition of our work on locomotives, it will be found that in the two experiments under consideration, the work done by the Fury, in carrying the two loads of 43·8 and 51·16 tons, besides tender, from Manchester and from Liverpool respectively, to the other end of the line, was

43·8 tons, from Manchester to Liverpool, equal, gravity included, to -	1964 tons to 1 mile.
51·16 tons, from Liverpool to Manchester, equal, gravity included, to -	1837 tons to 1 mile.

We see, therefore, that when we take an account, as we ought to do, and as Mr. Parkes has not done, of the surplus of labor caused by gravity, the work required of the engine is in reality more in the first case than in the second, although the load itself is less. Consequently the engine ought to have accomplished the second trip in less time or with a greater average velocity than the first, which in fact it did, and which had led Mr. Parkes to pronounce with such "certainty" the experiments to be eroneous.

This example shows that the calculation of Mr. Parkes, made with an erroneously averaged and exaggerated velocity, in which, moreover, he omits the gravity on the inclined planes, the resistance of the air, the friction of the engine, and all the other resistances really opposed to the motion, leads him to a *very inaccurate* measure of the work performed by those engines; and this refers to the whole of the results obtained, table ix., col 29—32; table x., col. 41—50; table xiii., col. 11, 12; table xiv., col. 9, 10, 11; table xvi., etc., and also to his comparison of locomotive and stationary steam engines, which we shall notice further on.

3d. After having calculated *very exactly*, as we have shown, the pressure of the steam in the cylinder, Mr. Parkes compares the result which he has obtained, with the total pressure on the piston resulting from the partial resistance suffered by the engine, according to the *Treatise on Locomotive Engines;* and as, in the first edition of that work, the author had confined himself to mentioning the pressure against the piston due to the action of the blast-pipe, without making any experimental research on the subject, Mr. Parkes, without noticing the results presented since in the *theroy of the steam engine*, (page 161,) takes the difference between the two results as necessarily expressing the pressure due to the blast-pipe (pages 82, 83;) and he demonstrates the inaccuracy of it. Here we perfectly agree with him; for besides the errors already pointed out in his researches of the pressure of the steam in the cylinder, every thing variable than can occur in the different data of resistance, now passes to the account of the pressure due to the blast-pipe, and must necessarily come to falsify the calculation of it. Thus, for instance, in the experiments, a great deal of water was lost by *priming*, and there resulted an apparent vaporization greater than the true one. A part of the difference between the calculated and the observed pressure was therefore to be attributed to that cause, though it could not be accurately measured; but, by the calculation of Mr. Parkes, it all passes to the account of the pressure due to the blast-pipe. Similarly, the resistance of the air, then imperfectly computed in the total resistance for an average velocity of about 12 miles per hour, is found, in all cases of greater velocity, to augment considerably the pressure due to the blast-pipe, and on the contrary to diminish it in all cases of less velocity. A favorable or an unfavorable wind necessarily produces similar effects. Thus, circumstances, combined with the fundamental errors already introduced in the calculation, raise or lower that pressure to all imaginable degrees (pages 87, 88, 90, 91;) and it will be readily imagined that such a determination cannot be exact.

4th. Mr Parkes has observed, in the experiments of the *Treatise on Locomotive Engines*, and particularly in two of them, made with the Leeds engine, and quoted in the *Theory of the Steam Engine*, that the useful effects produced by the same quantity of water vaporized varies, according to different circumstances, and he is amazed at it; for, as he affirms, the useful effects produced by the same quantity of water vaporized, in the same time and under the same pressure in the boiler, ought in all cases to be identical (pages 104, 119.) But this again is merely an error of the critic; for if we suppose a locomotive engine drawing a heavy load at a small velocity, since it is only at a small velocity that the engine has to overcome its friction, as well as the atmospheric pressure against the piston, and, above all, the resistance of the air against the train, it follows that out of the quantity of total work executed, there will be but a trifling portion lost in overcoming those resistances; but if, on the contrary, we suppose the same engine performing precisely the same quantity of *total* work, but drawing a light load at a great velocity, it is obvious that a much greater part of the work done will be absorbed in moving, at that velocity, the resistance which represents the friction of the engine, as well as the atmospheric pressure against the piston, and in overcoming the resistance of the air, which increases as the square of the velocity; and consequently there will remain a much smaller portion of it applied to the producing of the useful effect. Hence, in the two cases considered, the useful effects produced by the same quantity of water vaporized, so far from being identical, will, on the contrary, be very different from each other. Mr. Parkes may, besides, satisfy himself on this point, by perusing the *Theory of the Steam Engine,* in which he will find numerous examples of steam engines, in which the useful effect of one cubic foot of water varies in very wide limits, according to the velocity of the motion or the load imposed on the engine; and he will find it explained theoretically in chapter XII., of the *Treatise on Locomotive Engines,* or in chapter III., article 11, of the *Theory of the Steam Engine.* Thus Mr. Parkes's reasoning errs again by the basis itself.

5th. But there is another principle to which Mr. Parkes would subject all the observations of vaporization of locomotive engines. He remarks that in the two experiments above cited, the total resistance opposed to the motion is different in the two cases. Consequently, says he, the quantities of water vaporized by the engine in the same time must be in proportion to the pressures in the cylinder, and the experiments ought to satisfy this condition (pages 99, 100.) Upon this point he is merciless.

To establish this new principle, Mr. Parkes recurs to the *Treatise on Locomotive Engines* itself. He quotes a passage, in which, supposing the same engine travelling the same distance with two different loads, the author says postively that the distance travelled being the same in both cases, the number of turns of the wheel, and consequently the number of strokes of the piston given by the engine, that is to say, the number of cylinders full of steam, or finally the total volume of steam expended, will also be the same in both cases; whence results that the same volume will successively have been filled with two steams at different pressures, or in other words, at different densities; and consequently the quantities of water which have served to form those steams will be in proportion to their respective pressures (page 310—312 of the first edition.) Thus, this passage establishes very distinctly that the quantities of water vaporized, *for the same distance,* are in proportion to the pressures of the steam in the cylinders. But what does Mr. Parkes conclude from this? Why, that the quantities of water vaporized *in the same distance* are in proportion to the pressures in the cylinder. Now it happens to be just the contrary; for, if we suppose, by way of example, the two pressures to be in the ratio of two to one, the volumes of water vaporized for the same distance traversed, will also be in the ratio of two to one; but if the time employed in performing the distance in qustion be two hours in the first case, and one hour in the second, it is plainly the quantities of water vaporized in two hours and in one hour respectively, which will be one to the other in the ratio of two to one, so that the vaporizations per hour, or *in the same time,* will be equal, instead of being in the ratio of the pressures. Thus it is clear again that Mr. Parkes's principle rests but on a new error, which consists in making a confusion between the vaporization for the same distance and the vaporization for the same time.

6th. A final observation of Mr. Parkes (pages 89, 90, 98,) is this, that in some experiments, the locomotive engines produced, for the same quantity of water vaporized, a greater useful effect than several stationary high pressure steam engines, or even than several condensing steam engines; and he considers this result as a proof of the inaccuracy of those observations; for, says he, the locomotive engines having to contend with the pressure arising from the blast-pipe, which the high pressure engines have not, and also with the atmospheric pressure, neither of which resistances the condensing engines have to contend with, it is incontestable that they cannot even produce equal effects, much less superior ones (page 104.) But this reasoning is as unfounded as those we have already noticed; for, since the useful effect of steam engines, for the same vaporization, diminishes as the velocity of the motion increases, which has been already explained above, and which is found developed, either in chapter XII., article 2, of the *Treatise on Locomotive Engines,* second edition, or in chapter III., article 2, section 1, of the *Theory of the Steam Engine,* it is easy to conceive that a locomotive working, for instance, at its maximum useful effect, that is to say, with its maximum load, and consequently at a very small velocity, at which the pressure due to the blast-pipe and the resistance of the air are nearly null, can produce a useful effect greater, nay, much greater than a stationary high pressure engine, working on the contrary with a light load and a great velocity. The same inferiority of effect may also occur in a condensing engine, because an engine of that system working, for instance, at 16 lb. pressure per square inch in the cylinder, and condensing the steam to 4 lb. per square inch *under the piston,* where the pressure is always greater than in the condenser, loses, by that fact alone, a quarter of the power which it applies; whereas a locomotive, working at 5 atmospheres in the cylinder, and at a very small velocity, which renders almost null the pressure due to the blast-pipe, suffers, by the opposition of the atmospheric pressure, a loss equal to only one-fifth of its total power. Hence, definitively, in the latter engine, the counter-pressure against the piston destroys a smaller portion of the total power applied, and consequently, without even noticing the difference of friction of the two engines, or entering into any other consideration relative to the velocity, it is conceivable that the useful effect of the loccmotive may be found greater.

But if a more complete calculation be desired, it will be easy to furnish it; for the relative volume of the steam at 16 lb. pressure per square inch, being 1672 times that of water, it is plain that if S represent the number of cubic feet of water vaporized per minute in the boiler, and if a represent the area of the cylinder expressed in square, feet, 1,672 S will be the volume of the steam generated per minute, whence results that $\frac{1672\,S}{a}$ will be the velocity, in feet, per minute, assumed by the piston of the engine working at that pressure. Moreover, the *effective* pressure of the steam or the load which the piston can support, is 16—4=12 lb. per square inch; which gives $12 \times 144\, a$ for the total resistance, in pounds, supported by the piston. Thus, in the condensing engine, the effect produced by the number S of cubic feet of water, expressed in pounds raised one foot per minute, is $1672 \times 12 \times 144\, S = 2{,}889{,}216\, S$. Calculating in the same manner the case of the locomotive engine, we find that the effect it produces for the same vaporization S, working at the total pressure of 75 lb. per square inch, or at the effective pressure of 60 lb. per square inch, and expressed in pounds raised 1 foot per minute, is $381 \times 60 \times 144\, S = 3{,}291{,}840\, S$. Therefore, finally, its useful effect, per cubic foot of water vaporized, will exceed that of the condensing engine, and this again is a circumstance, examples of which will be found in the *Theory of the Steam Engine.*

Thus this new peremptory condition which the experiments ought to satisfy, is as unfounded as the former ones; and, in fact, Mr. Parkes contradicts it, himself, a little further on (pages 157, 158,) so that we might have referred his first argument to his second, for refutation. But, besides the foregoing observations, it must be borne in mind that the velocities employed by Mr. Parkes, for locomotive engines, being nearly all considerably augmented, as has been explained above, he must necessarily arrive (pages 85, 87, 89, 92, and tables x., xiii., xiv., xvi.,) at exaggerated results, for the effects which he supposes to have been produced by those engines; and therefore his comparison between locomotive and stationary engines, is altogether founded upon false calculations.

It is remarkable, finally, that in applying the preceding considerations to all the experiments published on locomotive engines, by different engineers, namely, Messrs. R. Stephenson, N. Wood, E. Woods and Dr. Lardner (pages 102, 117, 118, 159,) Mr. Parkes finds that the conditions to which he proposes to subject those experiments are not verified in them. Such a result ought to have put him on his guard against the validity of his own arguments; but the want of knowledge in the principles of machanics and of habit in mathematical reasoning (the author tells us that he is more accustomed to handle the hammer than the pen,) causes him to heap errors on errors, combining and complicating them unawares, till he arrives at a point where he does not produce a single result that is not erroneous.

There is a matter of surprise in the numberless errors contained in the paper of Mr. Parkes, and of which, for the sake of brevity, we have noticed merely the principal ones, reserving the rest for another opportunity if necessary. But on inquiring what was the end he had proposed to himself, what was to be definitive consequence of his labor, one is yet much more surprised.

His object is to propose a new measure of the effect of locomotive engines; and this *new* measure is what he calls the "momentum" generated, that is to say, "the product of the mass, in tons, of the engines, tender and train, multiplied into its velocity, in feet per second." This standard is to "represent the respective mechanical effect produced per second by each engine," (page 128.)

Now, the true mechanical produce includes the whole of the resistances and frictions really overcome by the engines; that is to say, the friction of the carriages, the friction of the engines, the gravity of the mass on the different inclines traversed, the atmospheric pressure, the pressure due to the blast-pipe, the resistance of the air, etc.; and in multiplying the sum of all these resistances, by the velocity of the motion, we shall have the mechanical effect produced. But, if among all those divers resistances, we take account *only* of the friction of the carriage, and the engine, omitting all the rest, and if we suppose, for an instant, that friction to be 6 lb. per ton, as well for the engine as for any other carriage, we shall have the effect produced, in multiplying the weight of the train, tender and engine included, first by 6 lb., and afterwards by the velocity of the motion. Now, it is evident that in calculating thus, we shall have exactly the same number given by the computation of Mr. Parkes, excepting that all of them shall be multiplied by 6. Therefore, the new measure proposed comes merely to this, that the effect of the engines will be calculated by the friction of the carriages only, and that of the engine considered as a mere wagon, and the results divided by 6.

But, as this pretended "standard" comprehends only a portion of the resistances really overcome; as it does not include the gravity of the train, which may, according to circumstances, offer a resistance exceedingly great, or null, or even act in favor of the motion; as it does not include the counter-pressure due to the blast-pipe, which varies according to the velocity, the rate of vaporization and the size of blast-pipe; as it does not include the total friction of the engine, but only the friction of its wheels, as a single wagon; as, above all, it does not include the resistance of the air, which, from experiments of which Mr. Parkes is "utterly ignorant" (page 124,) varies according to the bulk of the train and the square of the velocity, so that the quantity neglected, on that account, in the calculation may, at times, be quite trifling, and at other times, exceed the *momentum* of Mr. Parkes itself; as in fact this pretended *new* measure is nothing more or less than the common *useful effect* of the engine, as given in many works and particularly in our *Theory of the Steam Engine*, and *Treatise on Locomotiv Engines*, with these differences only, that in Mr. Parkes's calculation, it includes also the weight of the engine, and that it is erroneously computed, inasmuch as, the multiplying the weight of the train, in tons, by the velocity, the calculation is made as if the whole weight were raised up in the air by the engines, instead of being dragged or rolled along the rails; as, finally, this pretended standard, instead of being constant, varies with the velocity, just as well as what Mr. Parkes calls the *commercial* and *useful* effects, so that it is not more easy to know the one than the others, or that the rule of Mr. Parkes, which we are going to quote, refers to the one just as well as to the others; for all those reasons, then, we see that the aforesaid measure is not new, that it does not measure the mechanical effects of the engines, and finally that it is nothing more or less than the common useful effect (weight of engine included,) calculated in considering the whole train raised up in the air and the engine as a mere wagon.

After having thus found upon *reasoning* the accuracy of his new measure of the mechanical effect of the engines, Mr. Parkes proceeds to show the "powers of this method of analysis" (page 131.) Collecting all the erroneous results which he has obtained in his tables, and admitting then, as accurate, the experiments of the *Treatise on Locomotive Engines,* which he thought of demonstrating false before, Mr. Parkes forms a table in which he sets in view, on one side, the vaporization effected by the engine, and on the other side the useful effect produced, giving it only the name of *momentum,* when it includes the weight of the engine besides that of the wagons. Then comparing the vaporization to the effect produced, and taking an average, not upon his own experiments, *since he has made none,* but upon all the experiments which he has collected from the divers works published on the subject, he presents (page 130,) as the result of his labors, the following conclusion, which he proposes to substitute in place of every other kind of research on locomotive engines.

When the velocity of a locomotive engine is augmented in the proportion of 1·52 to 1, the vaporization necessary to produce the same effects varies in the following proportions:

To produce an equal *momentum* (an equal useful effect, weight of wagons and engine included,) in the proportion of 1·42 to 1, or in a proportion something less than that of the velocities; to produce an equal *commercial* gross effect, (an equal useful effect, including the weight of the wagons,) in the proportion of 2·43 to 1, or nearly as the square of the velocities; to produce the same *useful* effect (the same useful effect, nett weight,) in the proportion of 3·11 to 1, or nearly as the cubes of the velocities.

This is the definitive result which Mr. Parkes has attained, and the help of which seems to him to render it needless henceforward to seek to determine either the friction of the wagons, or that of the engines, or the resistance of the air, or any thing in fact that may influence the effects produced; researches which appear to him to offer insurmountable difficulties. Possessed of the *wholesale* result of Mr. Parkes, nothing more will be needed. Does any one wish, for instance, to know what load a given engine will draw at 25 miles per hour, on a given inclination? to know what velocity it will assume with a load of 60 tons? to know what is the maximum of useful effect that it is capable of producing? to know what proportions must be given to it, in order to obtain desired effects? Why, having recourse to Mr. Parkes's result, the solution of all these questions is self-evident!

It is evident, on the contrary, that Mr. Parkes's result, even were it exact instead of being founded on erroneous calculation, could lead to but one thing, namely, to find the useful effect produced by an engine at the velocity of 30 miles per hour, when the same effect, in quite similar circumstances, is known at the velocity of 20 miles. But, even then, making use of so rough an approximation, in which all is thrown in the lump: friction of the wagons, friction of the engine, resistance of the air, resistance owing to the blast-pipe, etc., the result could never be depended on. Assuredly, calculations like these do not tend to the progress of science; they would rather lead it back to its first rudiments. For this reason we persist in our belief that the only means of calculating locomotive engines, is to endeavor to determine, as exactly as possible, each of the resistances which oppose their motion, and by taking an account of the value of those forces in the calculation, we may then in every case attain a valuation really founded in principle, of the effects of every kind that are to be expected from them.

EARLY NOTICE OF THE NEW YORK AND ERIE RAILROAD.

The following article originally appeared February 22, 1828, only a few days subsequent to the death of the immortal Clinton. The communication was written by Mr. Boughten, of Virgil, and is worth preserving, as being the first *published* allusion, at least, to the New York and Erie railroad.

[From the Courtland Observer, February 22, 1828.]

The subject of internal improvement has been one of engrossing interest in this State, for several years past, and the facilities of conveyance have been greatly increased. The Grand Canal, extending from the Hudson to Erie, through the north part of this State, has proved of great advantage to the people at large; but the benefits derived from it have been realized, more particularly, in the parts adjoining it.

Still, in the winter season, farmers and others, who wish to transport property, have not the means in their power. This is true of those who reside near the canal; but the inconvenience is felt in the southern counties, to a great degree, in all seasons, as it is at a great expense that they ever take their surplus produce to the canal. Whenever this is done many embarrassments are experienced, which are not felt by those who live near the canal. To obviate these difficulties, and furnish the southern counties with a mode of transportation in many respects equivalent to the canal in the northern, a State road was projected to commence on the bank of the Hudson, and extend to Lake Erie, through the south part of the State; but after all that has been done, it is likely to fail. No communication has been provided to the Hudson, other than the northern and distant canal, and nothing is likely to be done towards the attainment of so desirable an object, unless some new suggestion should come before the public, that would excite attention and stimulate to persevering effort. The object of this communication is to enquire whether a railroad might not be constructed from some point either directly opposite or above New York, to Lake Erie, at or near the mouth of Cattaraugus creek. It is the opinion of your correspondent that a road of this discription may be formed between those places, on a tolerably direct route, without meeting any obstacle very difficult to be surmounted. I will now endeavor to present a general view of the country, distances, etc. between those places, which may not be perfectly accurate, as it is not all derived from personal knowledge, and none from actual survey.

Let the road commence at some point opposite New York, and continue as nearly in the course to Milford, in Pennsylvania, as practicable. Probably the best route might be chosen along the Passaic or Saddle river, to near its source, from which it might continue over the ridge to Milford. From Milford, probably a north-west direction, or nearly to the forks of the Lackawaxen, and along one of its branches near Bethany to Mount Pleasant; from Mount Pleasant to the head of Sarucca creek, on the height of land between the Delaware and Susquehanna rivers; thence down said creek to the Susquehanna, at or near Harmony; thence to Binghampton and Owego. From Owego it would be most proper to proceed along the bank of the Susquehanna, till a convenient passage shall be found to the Chemung river, above Tioga Point; thence up the river to Post Town; thence to Hornersville, or higher up the Canisteo; thence on the best route to the head of the Cattaragus creek, and along said creek to Erie.

On reviewing the proposed route, it is thought that no great difficulty will present itself in the State of New Jersey. A height is, however, to be surmounted at or near Paterson, equal at least to the falls of the river. It appears from an examination of maps, that but one or two ridges of importance are to be passed. The greatest height, it is apprehended, may be easily overcome. The distance through New Jersey is about 70 miles. From Milford to the Susquehanna, a distance of about 80 miles, there is only one height of importance to pass, which is at the head of the Lackawaxen and Sarucca creeks. From Harmony to Binghampton, is a gentle descent; from Binghampton to Owego, from Owego to the Chemung river, and up the Chemung to Post Town, and along the Canisteo to Hornersville, a route may be selected with comparatively little ascent or descent. From Hornersville to the head of Cattaragus creek, there are doubtless some ridges of consequence; but from the head of the creek to the lake, we find no obstacle of importance, there being only a moderate descent along the creek.

It is not to be expected that a subject of this kind could be presented to the public, and made an object of concern, without some opposition, and many objections. Among others we may expect the following:

1. It will incur a great expense.

It is true that it will occasion considerable expense; but let the subject be examined a little. On the 14th of January last, a bill passed the Assembly to incorporate the Ithaca and Owego railroad company. The capital stock is to be $150,000; the distance is about 30 miles which would make the estimate $5,000 per mile. The distance of the road contemplated, is probably not far from 400 miles. At the above rate it would cost $2,000,000, which would not be one-third the expense of the canal. But suppose it should cost $4,000,000, which would probably be the expense of one that would be permanent, it would then be only half the expense per mile of the canal.

2. The contempated road is to pass through several States.

To this it may be answered, that the distance between New York and Erie is less on this route than any other, and should it be constructed by this State alone, the expense would be proportionably less. But as it will be a great advantage to the other States, we may expect that they will do considerable towards its construction.

The Grand Canal has been completed at a great expense, and if there should be a railroad, much business would be taken from it, and thus render it unprofitable to the State.

In answer to this objection, it may be said that the canal has been finished but a short time, and the amount of business done on it now is very great. If it should increase for a very few years in the ratio that it has done, it would be exceedingly difficult to make much progress on it, in consequence of the great throng of boats, especially near the locks, and business would be thereby very much retarded.

Though the canal may have some advantages over a railroad, yet in many respects the latter would be superior. And first, property would not have to pass through so many agents, and thus many disappointments and mistakes would be prevented. 2d, by the use of the railroad, we might expect a more speedy conveyance of property. It has been stated that the force necessary to move a boat on the canal at the rate of 2½ miles per hour, would move the same on a level rail at the same rate. In moving faster than this, the railway has the pre-eminence, and ascents and descents are much more easily passed on it than on the canal. The distance is much less by way of the contemplated road, from any place midway between it on the canal, than it is on the canal. 3d, the railroad furnishing means of transportation at all times, the markets would not be so fluctuating as at present, but would be more steady and regular, and thus much embarrassment and bankruptcy would be prevented. All parts of the State would then be enabled to send their produce to market and enjoy nearly an equal share of the facilities for transportation. Should this be effected, there would soon be communications from the canal to the railway, in different places. That contemplated from Ithaca to Owego would be one, and doubtless there would be others of great utility.

The resources of our country are great. In the State of New Jersey are rich beds of iron ore, and the country is generally fertile. In Pennsylvania there are extensive coal mines, and the population and wealth are fast increasing. This State is also fast increasing in wealth and population. But when we look farther, and see the fruitful and extensive country in the west, fast filling with inhabitants, it may safely be anticipated, that abundant use will be found for both a railroad and canal, and that their construction would be highly beneficial to this and other States

[From the Civil Engineer and Architect's Journal]

ELECTRO-MAGNETIC PRINTING.

On Monday, August 2d, the first public exhibition of Mr. Bains's electro-magnetic printing machine took place in the lecture room of the Royal Polytechnic Institution.

The apparatus consists of a dial-plate, inscribed with the alphabet and numerals, with a revolving hand, worked by ordinary clock-work. On the other side of the room stood the important portion of the invention—that which furnished in type the communication to be sent forth from the dial-plate already described. Between these two machines a connection (capable of being extended in practice to any length) by means of wire conductors communicating with two electro-magnets placed on a frame, and connected with a cylinder covered with paper, upon which the type was to leave its impression—an horizontal wheel, in which types to correspond with the letters and figures on the dial were fixed. This wheel was ingeniously brought in contact with an inking roller, and these three portions of the machine were all brought into motion horizontally.

The party directing the communication stands at the dial-plate first described, and fixes a peg under the letter desired to be communicated. The index or revolving hand performs its rotation until its progress is arrested by coming in contact with the peg. A small trigger is then pulled, the galvanic power is then brought to bear by the aid of the communicating wires upon the two electro-magnets, with their machinery on the second frame, and the letter thus communicated is printed upon the paper affixed to the cylinder.

The operations excited universal admiration, and the machine itself is well worthy the attention of the curious, for though at present it may fail as a speedy means of communicating information in print, still by the adoption of a code of signals (by which one letter or character might be construed to denote a sentence or describe a subject) the invention might be made extremely valuable in the times in which we live.

Electro-magnetic exhibition.—A very interesting exhibition has been lately opened at number 8, St. Andrew square, Edinburgh. It consists of several working models of different machines, such as a turning lathe, a printing machine, a saw mill and a locomotive carriage, driven by the power of electro-magnetism. The inventor of these models is Mr. Robert Davidson, an ingenious mechanic from Aberdeen, who has been engaged upon them for the last four years, and who has succeded in effecting several improvements in the application of electro-magnetism, which promise to be of great practical value. He is the first, we understand, who has employed the electro-magnetic power in producing motion, by simply suspending the magnetism without a change of poles. The mode employed by Jacobi Davenport and Storrar, consisted in keeping the repulsive power (which is equal to a third only of the attractive power) in operation during the one half of the time, and the attractive power during the other half. Mr. Davidson's discovery consists in a simple and extremely ingenious method of communicating and cutting off alternately the galvanic current to and from a pair of electro-magnets that always act attractively, so as to exert a constant moving force upon the machine which is put in action. It has received the approbation of numerous scientific gentlemen, who consider that Mr. Davidson has succeeded in showing the perfect applicability of magnetism as a motive power to engines of every description. It would no doubt be desirable, however, to see experiments tried on a larger scale; which Mr. Davidson, we understand, is anxious to do, but is deterred by the want of funds.—*Scotsman.*

Travelling by electro-magnetic power.—We are informed that a distance of 57 miles has been travelled on the common road, in a Bath chair, by electro-magnetic power, in one hour and a half; and further, that the appiler comes over daily from St. Alban's to the bank of England in the said chair in half an hour at an expense of sixpence. The model of an electro-magnetic engine, which has been exhibiting at the Adelaide Gallery for some time, is an instance of ingenious mechanic arrangement, whereby contact is broken and renewed, the poles reversed, etc.; and from its performances gave great promise of practical powers on a larger scale. The battery employed is the nitric acid, or Grove's battery. Of the invention that has done the great feat, and established the successful application of this wonderful agent, we know little more than its success. We hear that the increase of power is due to the discovery of a new combination of elements; that this is the secret of the moving power; and that the battery is to be the subject of a patent.—*Literary Gazette.*

[Extracts from " Brief Facts in relation to the New York and Erie railroad"]

WESTERN RAILROAD OF MASSACHUSETTS.

This railroad, constucted by the funds raised by the citizens of Boston, and those of the State along the line of the road, also by a State loan of about $4,000,000, extends from Worcester to West Stockbridge 117 miles, connecting on the east with the Boston and Worcester railroad, 44½ miles long; and on the west, with the Albany and West Stockbridge railroad, 38½ miles in length; making 200 miles from Boston to Albany, in the hands of these joint stock companies. The following, from the Boston Atlas, since the completion of the railroad, shows the calculations of the Bostonians on the revenue for this year, of the Western railroad alone, 117 miles in length, which is but little more than one fourth of the length of the New York and Erie railroad.

Revenue of the Western railroad.—An intelligent friend, and one who is well acquainted with the subject, has furnished us with the following document, showing the probable income of this magnificent public work:—

Estimated nett revenue of the Western railroad for the year 1842, in case said railroad has a sufficiency of cars and locomotives.

Nett amount, after deducting toll to the Boston and Worcester railroad, and after deducting all other expenses:

100,000	bbls. flour for the Connecticut valley.		
100,000	"	"	Trade centering at Worcester.
20,000	"	"	west of Chester.
780,000	"	"	Boston.

1,000,000 barrels at 15 cents per barrel, Nett profit on an everage - - - -		$150,000
300,000 through passengers, being 500 each way, per day, at $1,50 each, nett profit, - - - -		450,000
Way passengers will probably equal, in profit, the through passengers: but say one half as much, nett -		225,000
50,000 hides to Green county, say -	625 tons	
100,000 sides leather, back - -	937½ "	
50,000 hides to other places at or near the road	625 "	
100,000 sides leather, back - -	937½ "	
At $2 per ton, nett profit on -	3125 tons	6,250
100,000 hogs, dead and alive, or in barrels at 50 cents each, nett profit - - - - -		50,000
20,000 head of cattle, dead or alive, or in barrels at $1,25 each, nett profit - - - - -		25,000
100,000 tons merchandize up, through freight at $2 per ton, nett profit - - - - -		200,000
50,000 tons way freight, of articles not enumerated, at $1 per ton nett profit - - -		50,000
2000 tons wool at $3 per ton, nett profit - -		6,000
10,000 bales cotton at 50 cents per bale, nett profit -		5,000
6,250 tons salt at $1 per ton, nett profit - -		6,250
30,000 tons boards and scantling, shingles, timber, staves and other wood, at $1 per ton nett profit -		30,000
40,000 tons pig iron, marble free stone, grindstones, plaister paris, mica slate, lime, and other stones, at $1 per ton, nett profit - - - - - -		40,000
1,000 tons fur and peltry at $3 per ton, nett profit -		3,000
4,000 tons pot and pearl ashes at $2 per ton, nett profit		8,000
5,000 tons cheese at $3 per ton, nett profit -		15,000
3,000 tons butter and lard at $3 per ton, nett profit -		9,000
10,000 tons coal at $1 per ton, nett profit - -		10,000
20,000 tons wheat at $1 per ton, nett profit - -		20,000
10,000 tons rye, corn, barley, and other grains, at $1 per ton, nett profit - - - - -		10,000
5,000 tons bran and ship stuffs, peas, beans, potatoes, at $1 per ton, nett profit - - - - -		5,000
500 tons clover and grass seed, flax seed, and hops, at $3 per ton, nett profit - - - - -		1,500
3000 tons furniture, at $3 per ton, nett profit -		9,000
2,000 tons iron ware, at $1 per ton, nett profit -		2,000
5,000 tons wooden ware, at $1 per ton, nett profit -		5,000
Estimated nett revenue of the Western railroad, for the year 1842 - - - - -		$1,341,000

which on its cost, $6,700,000, is 20 per cent. per annum.

This document has been prepared with very great care. Any one who will examine the detail of the trade on the Erie canal, during 1839 and 1840, (table 2 and other tables of Senate Documents No. 63 and 65 of New York Legislature for 1840 and 1841,) and will reflect on the fact that Massachusetts is the best market to sell a great amount of the products which come from the canal, and is also the best market to buy the goods wanted in return ;—any one who will reflect that the west produces, almost spontaneously, what we want, and desires to buy our manufactures, our fisheries, and our imports ; any one looks at the authentic fact that 3000 passengers go daily between New York city and Albany during eight months of the year, and who farther reflects that western New York and the whole west is full of Yankees, who desire to visit their kindred, and have their visits returned ; any one, who reflects that the amount paid for freight and passage on the Erie canal, and on the railroads parellel to it, exceeds $5,000,000 annually, and who also looks at the fact, that the Western railroad is a continuation of said railroad ; any one who takes up the present document, item by item, and after investigation, set down his own conclusions, and then foots up those conclusions—will come to a result, the magnitude of which may astonish him, and yet fall far short of sober reality.

Is it not then perfectly natural that the Western railroad, like the Grand Junction, the London and Birmingham, and other long lines of railroads in Great Britain—and like the Erie canal and the long lines of railroads along side of it,—should, by the magnitude of its nett revenue, astonish even the most sanguine?

INSANE PROJECTS.

When Columbus determined on the vast enterprise of seeking a new world, the courts of Genoa, Portugal, and for several years, that of Spain, looked upon him as a visionary mendicant. But he sailed upon his voyage, discovered America, and his tomb-stone bears the proud record, "*A Castilla ya Leon, Neu vo Mundo Dio Colon.*" To Castile and Leon, Columbus gave a New World.

When Fulton started his first steamboat, "Clermont," on the Hudson, he said that people shook their heads, and said that it was the project of a crazy man ; he accomplished his scheme and a thousand steamboats attest his praise.

When the steamship Savannah, sailing from this port crossed the Atlantic, and became the *first* steamer that ever touched the shores of both hemispheres, it was declared that it could not be done again, and that it was madness to try. The many steam-moved packets that now cross and re-cross, show the *insanity* of the project of Atlantic steam navigation.

When De Witt Clinton struck out in conjunction with an humble engineer, the grand plan of connecting the great lakes of the north, with the waters of the seaboard, he was ridiculed as a fanciful theorist, who had lost the balance wheel of his judgment. The Erie canal was however completed, and the mere tolls of the last year amounted to *two millions and thirty thousand dollars*, sufficient to pay off the entire interest of the State debt of twenty millions, and leave a surplus of over a million for incidental expenditures, to say nothing of the incalculable benefit this work has been to western New York, and the western States.

When the plan was first proposed of uniting the city of Boston, with the pier heads of St. Louis in Missouri, it was laughed at as the absurdity of a dreamer; and when General Dearborn spoke of tunnelling the Housatanic mountain, to get to Albany, they thought him almost qualified for a cell in the McLean Asylum. But the mountains have been crossed, Albany has been reached, it is even now a day nearer Europe in point of time than New York; the line of steam communication which shall unite the valley of the west, with the waters of the Atlantic, is fast being completed, will soon bind them in irrefragable alliance. These are but a few specimens of the projects which in their incipiency men have pronounced insane, and held up to derision. So will it ever be, with those, who lead on in advance of human progress, they are ridiculed as enthusiasts, regarded with distrust, taunted with madness. The rewards of genius lie in the future; the generation which surrounds such men seldom appreciate or understand their value, and yet, but for these men, who throw themselves forward into coming ages, and disclose the vista of human improvement, society would stand still, or revolve like that of China, in a perpetual circle without advancing in arts, in knowledge, in goverment, or religion, speculation produces theory—theory, experiment—experiment, result; and these results giving impetus to mind, carry forward society to the threshold of new projects, which in turn are denounced as visionary and insane, which in turn are verified, which in turn are soon looked back upon, as old and established truths; in the reaching forward of man, after still newer schemes, and still bolder designs. Who shall set limitations to the devices of an illimitable mind.—*Georgian.*

NEW LOCOMOTIVE ENGINE.

I have examined with much pleasure another important improvement in the locomotive engine, by our ingenious and enterprising townsman, M. W. Baldwin, Esq. This improvement consists in an attachment of power to all the wheels, six in number, in such a way as to obtain the adhesion of the whole weight of the engine to propel the load, while all the advantages of a vibrating truck under the front end of the engine in accommodating the curves and undulations of the road, are preserved, as in Mr. Baldwin's ordinary six wheeled engine, in which only two of the wheels are used to propel the load. This advantage is highly valuable and important, and will be readily appreciated by managers and engineers who are familiar with locomotives, and the difficulties heretofore experienced in overcoming high grades, from a want of adhesion in a light engine. The hindmost wheels of the engine (two in number,) are 44 inches in diameter, and the forward or guide wheels attached to a vibrating truck (four in number) are 33 inches in diameter. The hindmost driving wheels carry (including their own weight,) 11,775 lbs, and the front wheels carry, including their own weight, 13,225 lbs. Total weight of engine, with water and fuel, 30,000 pounds, or 13 tons, 7 cwt. 3 qrs. and 12 lbs.

This engine has been performing for a few days on the Columbia railroad, between the bridge and the city, in making experiments, which have resulted highly satisfactory to Mr. Baldwin, and a number of scientific gentlemen who have attended several of them. No opportunity has occurred yet for an experiment with a sufficient number of cars to prove the full power of the engine. Yesterday, the 25th inst. she drew from the bridge to the city a train of seventy-three loaded cars, being the Reading freight train; weight of merchandise, 200 tons, weight of cars, 130 tons, making a total gross load of three hundred and thirty tons, exclusive of the weight of engine and tender. This performance was upon a portion of the road having numerous curves and grades, the latter rising 30 feet per mile in the direction the train was moving. The engine passes with ease round a curve of 90 degrees, upon a radius of 312 feet. After the engine was detached from the train she was run round a curve of 90 degrees upon a radius of only 75 feet, without extraordinary friction.

This improvement will no doubt be duly appreciated by the railroad community, and will add to the present high character of its talented projector. All who feel interested should take an early opportunity to examine this engine, as it will be removed to the Reading railroad in a few days. C. E.

[*United States Gazette.*

Edinburgh and Glasgow Railway.—It is gratifying to observe the incessant exertions which are making every where on the line in the vicinity of this city to get this national undertaking completed. The magnificent entrance to our great tunnel is drawing to a conclusion, while the booking and other offices are all but finished. The landing and departing platforms are now getting very handsome sheds, with elegant cast iron supports set up; and the ground is clearing out for laying the permanent rails. Yesterday, Mr. John Craig, the mineralogist, made a survey of the tunnel, in furtherance of the objects of the British Association, and proceeded right through it, in company with the very polite and spirited contractor, Mr. Marshall. Amongst many other geological specimens got in the journey, we saw perfect masses of the *Nucula Tumida, Producta Scotia, Producta Martinnii, Bellerophon Urii,* and *Apiocrinites,* imbedded in a shale, above a two feet limestone, with many other interesting remains of a period long before the creation of man.—*Glasgow Constitutional.*

Cheltenham and Great Western Union Railway.—Contracts have been taken, and in some instances the works have been commenced, for carrying on this line from its present terminus at Cirencester towards Stroud and Gloucester.—*Cheltenham Looker-on.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

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STUART ON RAILROAD PILING.

The communication from Mr. Stuart was received after our article requesting information, in the last number, was in type. It is, however, in precise accordance with the requirements there mentioned, and is therefore peculiarly acceptable. To Mr. S., among other gentlemen favoring us with such communications, we need hardly say that we feel much indebted to them, and that we shall look forward to a continuation of Mr. Stuart's essay.

[For the American Railroad Journal and Mechanic's Magazine.]

Engineer's Office, Susquehanna Division,
New York and Erie Railroad,
Elmira, *January* 25, 1842.

Gentlemen: In compliance with a request made by you sometime since, desiring further information in regard to the grading by *piling* on the Susquehanna division of the New York and Erie railroad, I herewith send you an *abstract of the weekly reports of the inspectors* having charge of the several steam pile machines which have been in operation during the past summer and fall on this division, by which you will see that the 8 *steam pile drivers* have driven and sawed off, ready for the superstructure, 43.17 *miles of piling for piled road*, in 890 days of 10 hours each; or an average for each machine, of 102 piles per day, *equal to* 16 *rods of grading per day*, or 1.26 *miles per month*. The *largest* number of piles driven by 1 machine in 1 day, *was* 280, *equal to* 34 *rods*, or at the rate of 1 *mile in less than* 8 *days*. The *greatest* number driven in 1 *week, was* 1,187, equal to 1 *mile in less than* 11 *days.*

Abstract of weekly reports of inspectors of piled road on the Susquehanna division of the New York and Erie railroad.

No of machine.	No. of days machine at work.	No. of piles driven and sawed off above the surface of the ground		Total number of piles driven and sawed off.	Largest number of piles driven and sawed off.		Average number of piles driven each day.
		Under 5 feet.	5 feet and over.		In one day.	In one week.	
No. 1	117.7	13,889	151	14,040	230	840	119
" 2	111.7	9,548	1,455	11,003	182	826	98
" 3	129	8,584	1,467	10,051	240	940	78
" 4	98.1	8,150	547	8,697	194	784	89
" 5	116	11,149	1,245	12,394	280	988	107
" 6	128.2	11,688	1,220	12,908	208	1,000	100
" 7	114	13,872	1,627	15,499	269	1,187	135
" 8	76.1	5,200	1,381	6,581	180	642	87
	890.8	82,080	9,093	91,173			

Miles of piling sawed off *less* than five feet above the surface of the ground, - - - - - -	38.865
Miles of piling sawed off *five* feet and over, from the surface of the ground, - - - - - -	4.304
Miles of piling driven and sawed off, (ready to receive the superstructure) in 890 days, averaging for each machine, 102 piles per day, or 1.26 miles per month, - total,	43.169
Miles added, for piling, done by the steam pile drivers, from the 1st to the 22d day of May, (the time that an inspector was appointed specially for each machine,) and you will have the miles of piling done since the 1st of May, - - - - - -	4.581
Amount, - - - - - - -	47.75

One hundred and eight miles, of this division of the road, *will be founded on piles* of which distance, 74 *miles is now piled, ready for the superstructure.*

The piles used, are mostly of *white oak* timber, from 8 to 30 feet in length, and from 11 to 20 inches in diameter at the butt or top end of the pile. They have been driven through every variety of earth to the depth of from 5 to 25 feet. Every pile is driven to a firm foundation, and nothing will prevent their reaching the requisite depth, except hard pan or rock. The piles are driven by hammers, weighing 1,000 to 1,400 pounds each; and falling, the last blow, 30 to 35 feet. The fuel required for the machine is principally supplied from the tops of the piles sawed off; and the water used is hauled by horse and cart from the nearest stream or fountain. The machine is propelled by an engine of 10 horse power, and when in full operation, gives 15 to 20 blows by the hammers per minute. Each machine is manned by 9 men, and worked at an expense of $12 per day. The piles are driven 5 feet from centre to centre, longitudinally, and 6 feet transversly.

The expense of butting, sharpening and arranging the piles, ready for the pile machine, averages about $200 per mile. The average cost for working the machine, per mile, $250. *Use* and repair of machine and other incidental expenses, about $250, amounting in all to $700 per mile,—*exclusive* of detention and the expense of taking down and removing the machine from one portion of the road to another. The white oak timber costs, on an average, 3½ cents per lineal foot, or, $1,000 per mile, delivered on the line.

Thus you will perceive, that by the aid of *steam*, we can construct with an ease and rapidity *unprecedented*, a railroad upon a plan *better adapted to our climate*, than any which has heretofore been adopted; and by an improvement, easily made on the machines, used on this work, a much larger amount of piling can be done in the same number of days, than is shown in the foregoing *abstract*; and I do not hesitate to say, that our *steam pile drivers* by a proper application of steam, and with hammers weighing from 1,200 to 1,400 pounds, will drive, on an average, 2 *miles of piling* per month, from the 1st of April to the 1st of November.

I will, in a few weeks, if leisure permits, send you a further statement of our *experience* in the construction of *piled road* on this division, presuming that any information on this *new* and interesting branch of railway construction, will be acceptable to the profession, as well as to your readers generally.

Truly yours,

C. B. Stuart.

Chief Engineer Susquehanna Division,
New York and Erie railroad.

[For the American Railroad Journal and Mechanic's Magazine.]

Gentlemen: Permit me to trouble you with a few more observations in defence of my pamphlet.

It appears to me that you have almost overlooked the subject which I argued, and confined your remarks to the question raised by yourselves and your correspondent. I did not pretend to discuss the question, whether it be better to adapt the capacity of a railroad and its furniture to the trade existing at the time the work is commenced, or to the *greatest possible* trade which can be antcipated in all future time, or to some reasonable intermediate amount of trade, which the good sense of the company might prompt them to make the basis of their plans. I have treated no such problem, and have written nothing of late on that subject, which is a matter of some importance, certainly, and in many cases will be found deserving of much temperate consideration; but my inquiry was directed to another object.

There are some routes on which railroads are proposed,—extending for instance, from important points on the western waters to commercial cities on the Atlantic,—where a vast trade and travel (say two or three hundred thousand tons, and as many hundred thousand passengers) may "reasonably be anticipated," (such is my language,) and there are many other routes where eight or ten thousand tons and five or six thousand passengers per annum, are more than can ever "reasonably be anticipated." The reasonable anticipations of the one class, are from five to ten, and from ten to fifty times greater than the reasonable anticipations of the other class.

The question is, whether all these roads should be made alike—whether the rails of all should be made of the same strength—the engines of the same weight and power—and the cars of the same size;—whether the same expense should be encountered on all for the purpose of reducing the grades and cheapening the cost of transportation—or whether all these points should be ruled by the character and amount of the trade.

This is the question which I discussed, and I did not even broach the other, which I regard of vastly inferior magnitude, and comparatively of little importance to the community.

I contended with sincerity, and I thought very reasonably—though my view is opposed to the practice which prevails in the country—that a much larger sum might be expended, with good economy, in grading, to reduce the cost of conveyance on one hundred thousand tons, than to obtain an equal reduction on a trade of ten thousand tons. I have thought that as very small engines might carry a very small trade with ease, it would be better to make a permanent, though light and cheap road, to bear the weight of such engines, than to construct a heavy and temporary superstructure, and put on very powerful engines to tear it to pieces.

And I supposed that as eight or ten passengers could be carried very cheaply and comfortably in one or two very light cars, it would be better to employ such cars on small roads, than encounter the expense of the huge boxes usually employed, the weight of which is injurious to the road, and which are rarely if ever half filled. I have deemed it best, to repeat the language of the pamphlet which you condemn, to "make the provision in all cases commensurate with the duties to be performed—the trade and travel to be accommodated."

You do not concur with me in these views, but think with your correspondent, that "the *great* objects and purposes of railways have been misconceived by Mr. Ellet," and that, "the modifying scale required by his plan, though applicable to the steamboat from its transferrable character, is not applicable to the railway, which, as a fixture, looks to the future."

You contend, that to think of adopting my plan, and regulate the power and capacity of a railroad and its machinery merely with a view to the "certain accomplishment of the duty to be performed," to "the economical accommodation of the trade which it is found may reasonably be anticipated," (such is my language,) to make great roads and provide great machinery for a great duty, and light roads and light machinery for a light duty, "would be inconsistent with the onward character of the age," and "return us to an era prior even to the stage coach."

This is the issue. Let public opinion,—or what is much better than *any* opinion,—let a few years' more experience, decide between us.

I am happy to find that there is now but one opinion in respect to the matter of tolls, and that all concur in the propriety of regulating such charges with an eye to the laws which govern trade. This indicates a considerable change within the last few years.

I am much obliged to you for giving place to my views in your useful Journal, and if you can bear with me a little longer, I will endeavor to show you shortly wherein we differ in our estimate of the value of time and velocity.

Respectfully yours.

[For the American Railroad Journal and Mechanics' Magazine.]

REPORT OF THE CANAL COMMISSIONERS OF THE STATE OF NEW YORK.

This report for 1841, furnishes data which may be classified under the following heads as assisting to give a clearer view of the subject treated of:

Public works and their finances—

	Miles.		
Erie canal,	363		
Champlain canal,	77		
	——	440 miles productive, cost,	$10,500,000
Oswego "	38		
Chemung "	39		
Crooked lake "	8		
Chenango "	37		
Black river "	38		
Genessee Valley	35		
Cayuga and Seneca	23		
	——	278 miles unproductive, cost,	7,400,000
Enlargement of the Erie canal, expended up to January 1, 1842, - - - - -			10,800,000
			$28,700,000
Deduct for Erie and Champlain canal, liquidated by tolls, salt and auction duties, *between* 1825 *and* 1840, *or in fifteen years,* - - - - -			10,500,000
Leaving of State debt on 1st January, 1842, about,			$18,200,000

The following sums have been lent by the State to private corporations, and for the due payment of which she is liable:

Delaware and Hudson canal, - -		$800,000
New York and Erie railroad, - -	$3,000,000	
Ithaca and Oswego " - -	315,700	
Canajoharie " - -	200,000	
Tonawanda " - -	100,000	
Auburn and Syracuse " - -	200,000	
Hudson and Berkshire " - -	150,000	
Corning and Blossburg " - -	70,000	
Long Island " - -	100,000	
		4,135,700
		$4,935,700

All these may be considered as ultimately good for both principal and interest.

The State also holds of the surplus revenue from the General Government in *perpetual deposit* the sum of, - - - - - - -	$3,500,000

Contracts have been made for work on the lateral canals and to complete the enlargement of the Erie canal between Albany and Utica, or about half its length, amounting to, - - - - -	$4,600,000
Deduct amount to be supplied from surplus canal revenue in next three years, $500,000 per annum,	1,500,000
Amount required to be raised by loan in the next three years for the above objects, - -	$3,100,000

The estimated cost to complete all the lateral canals and the enlargement of the Erie canal, between Utica and Buffalo, say, - - - -	$14,200,000

In this statement, New York exhibits the lucky spectacle of having confined her first efforts to the completion of the great MAIN STEM, the invigorating effects of which were allowed to diffuse themselves throughout the State before she ventured to extend the system, when it was still her object to play into the lap of that great artery. The consequence is now seen, in not only the redemption of the entire cost of the main stem in about fifteen years, but the present revenues of her works, besides paying the interest on her present debt of $18,000,000 made up of $11,000,000 expended in the enlargement of the main stem, and of $7,000,000 in the creation of near three hundred miles of laterals, leave a surplus of about $800,000 for other purposes.

But the item of most particular felicitation to the State is, that nearly the whole of the large tonnage passing over the canal, is derived from business created by this very improvement, aided by its laterals and the railways which have been induced along its whole line.

The whole amount of tonnage passing over the main canal is about, - - -		1,450,000
Tonnage passing west from the city of New York to Buffalo for ports beyond it, -	65,000	
Tonnage passing east to Albany from ports beyond Buffalo, - - - - -	150,000	
		215,000
Tonnage from business on the line of the canal, tons,		1,235,000

Revenue—	
By tolls received, - - - - -	$2,035,000
" Interest on investments, - - - -	141,000
	$2,176,000
Expenditures—	
To interest on State debt, - - - - -	$900,000
" Interest on non-paying railways, - - -	25,000
" Repairs and superintendence of canal, - -	471,000
" Surplus amount applied to general fund, - -	200,000
" " " " to other purposes, -	580,000
	$2,176,000

Such is this flourishing account which has more than justified the calulations of Messrs. Verplank and Ruggles, of the legislature, in 1838, of an annual increase of $100,000, it having been at an average of $144,000 per annum in the last three years. Thus has this great work completely established its own independence beyond the reach of any rivals, while it must go on annually increasing its resources by the accession of new customers, such as the late connection recently made by it at Albany with the Western railway leading to Boston.

The enlargement is to be regretted as premature; the capacity of the old canal being as yet but little more than about half filled. If it really required relief, the railways on its line ought to have been first tendered whatever there was of surplus; and if the fear of competition from them could ever justify the restrictions on them, still less can it do so now, when the whole cost of the canal has been redeemed from the general funds of the State.

Towards the advancement of railways, the State has done nothing yet on her own account, having contributed her credit only to sundry corporations to the amount of about $4,000,000. Of these, only two have failed to pay their interest, amounting to $24,000, while the deficiency on the lateral canals absorbs about $377,000 from the general revenue. In time, however, these will support themselves besides contributing largely to feed the main canal.

It is now time for the people to understand that the canal or centre tier counties have been even pampered at the public crib, and that those north and south are entitled to their fair share in all future application of the public credit. Their preference is for railways; and if one reason was found to justify in its day the enterprise of the Erie canal, of which the ample fruits are now before us, there are at least two in favor of that of the Erie railway, founded in ascertained data. The State will scarcely therefore be so direlict of her own true interest as to allow that work to languish, if her further aid be indispensable to insure its completion.

We will suppose these two schemes, which now divide the councils of the State of New York and the opinions of its people, *the enlargement of the Erie canal and the Erie and New York railway*, both partially completed, as submitted to a suitable arbiter, say for instance, Lord Ashburton, whose fiat on questions of this sort would go further with the monied interests of Europe than perhaps that of any other person,—would he not say of the one, that it is premature by at least ten to fifteen years,—of the other, that it offers the most solid security as an investment; and to judge from the experience he had left behind him in the old conntry, as to the vivifying nature of this kind of improvement, its effect on a line of new country like that between the city of New York and Lake Erie, could not be otherwise than marvellous, and that if the question of preference is to be determined only by an *equitable distribution* of State favors, the Erie railway has the best claim. While the profitableness of the investment is UNDOUBTED, why dread going too deeply into it?

[For the American Railroad Journal and Mechanics' Magazine.]

REPORT OF THE CANAL COMMISSIONERS OF PENNSYLVANIA FOR 1841.

According to this report, the public improvements of Pennsylvania now consist of

Finished lines of canal, -			656 miles, now cost,	$27,000,000
Unfinished lines—				
North branch division, Lackawanna to Athens, - -	90			
Erie extension, Greenville to Erie, - - -	60			
Wisconissco canal, Wisconissco to Duncan's island, - -	12			
		162 " est. "		3,000,000
			818	
Finished lines of railway—				
Columbia, - - -		80		
Portage, - - -		36		
			116 miles, cost,	6,000,000
Amount carried over, - -			934 " "	$36,000,000

Amount brought over, - - - - -	$36,000,000
Add other debts due by the State in turnpikes, banks, etc.,	3,000,000
	$39,000,000

Making a total of $39,000,000 when all her unfinished lines are carried out.

It is utterly impossible to make anything like a satisfactory statement of the working of these improvements,—old debts, repairs and new work are not properly distinguished in the returns,—it is enough to know that with an unconnected *main line* and unfinished and delapidated laterals, the picture thus far is most disheartening.

As the result of these works, the pecuniary requirements of Pennsylvania in 1842, will be about as follows:

To meet interest on her debt, - - -	$1,800,000
" Meet ordinary expenses, etc., - - -	400,000
" Complete unfinished lines of work, say $3,000,000 in all, for this year, say, - - -	1,000,000
	$3,200,000

Borrowing being out of the question, the whole of this must be raised by taxation. It is *more* essential to complete the works than to pay the interest on the finished portions. And if it be a question of necessity for suspending one or the other, let it be the interest, for few will be hardy enough to say that with these works left as they now are, that the debt will ever be worth anything. It is for the holders of her bonds to submit in time to the sacrifice which may be required of them, and come boldly to the rescue of these assets. It is a bankrupt estate with which they have now to deal; and if rightly managed, will yet pay seventy-five per cent. certain, and perhaps a full hundred. It will be seen by the extracts we give below from this report, that a reformation is promised throughout in the general management of these works, upon the salutary effects of which must rest the hope of a gradual and final establishment of the credit of the State now at fifty per cent. below par.

More immediately interested in railways, we have endeavored to understand the working of the Columbia road, and are fully of the opinion that if the State had assumed the entire management of it, and kept it a distinct account, that it would not discredit the fraternity, with all the drawbacks it has had to suffer. An estimate of the expenses on this road for 1842, exclusive of repairs to road itself, is furnished in this report, and to render more distinct the dead weight and interruption of the inclined plane, we have separated the several items after the following manner :

Motive power—			
Wages to engineers and firemen, equal to 20 locomotives *in constant use*, - -		$23,000	
Fuel, coal $10,000 and wood $37,500, sawing latter $8,800, - - - -		56,300	
Oil, - - - - - -		6,200	
Repairs in workshops, $31,300, and at manufacturers, $8,000, - - - -		39,300	
		$124,800	
Deduct for two locomotives between incline plane and Philadelphia, $5,500, - - - -	$11,000		
Deduct fuel and oil for stationary engine, etc., - - - -	3,000		
		14,000	
			110,800
Inclined plane—			
Two locomotives between incline plane and Philadelphia, and oil and fuel for stationary engine, - - - - - -		14,000	
Horse power between incline plane and Philadelphia and crossing bridge, - -		6,500	
Attachers, engineers, firemen and laborers at stationary engine, - - - -		6,500	
New rope for plane per annum, - -		4,000	
Despatchers, etc., on levels, - - -		1,000	
			32,000
General charges—			
Watermen, - - - - -		6,200	
Water companies, - - - -		1,200	
Despatchers, State agents, at Philadelphia, Lancaster and Columbia, - - -		6,300	
State agents to passenger trains, - -		4,200	
Salaries of superintendent and clerk, -		2,500	
Miscellaneous, - - - -		1,000	
			21,400
			$164,200

The above is a fair estimate, under the circumstances; and could the inclined plane be abolished, the time gained thereby and the dispensing with the present outlay of $32,000, would make a saving in the general business of the road of at least $50,000 per annum! And were the forwarding business of freight and passengers done by the Government, the receipts would be increased $50,000. This road and the Camden and Amboy are generally referred to by those who would *wish railways to fail*, and the public seem scarcely yet aware that both, at the present day, are a sort of *satire* on the improvement.

"The Pennsylvania line of improvement is the most central, the most direct, and the shortest route, from the Ohio river to the cities on our Atlantic sea board; and it only remains to make it the *cheapest*, in order to make it the common thoroughfare, and secure the trade of the great region of the Ohio valley."

"To prevent the interruption of the trade of the Ohio river, and the consequent diminution of the business on our canals, a plan has been adopted for a new structure of steamboats to ply on that river, which are adapted to the lowest stage of water, and which, it is believed, will be fully competent to do all the business that will be afforded by the Ohio, during the next and succeeding years. The "Marion" is a specimen of this class; and her success has afforded a test of the experiment which places their utility beyond question or controversy. Several of this kind of boats have been already constructed: they are of a capacity to carry from forty to fifty tons, either in ascending or descending that river. They are built exclusively for *freight*, and with an especial and direct reference to keeping up the trade through the channel of our canal from Pittsburg to Philadelphia. We are happy to be able to state, for the information of your Excellency and the Legislature, that we have the assurance of several of the most enterprising men in the west, that arrangements have been made for such a number of this description of steamboats as will be amply sufficient to do the entire business of the Ohio river during the coming season, and that they will be ready to co-operate with the boats on our canal at an early period."

"The magnitude of the business within the possible influence of the Pennsylvania improvements may, in some measure, be appreciated by contemplating the extent and character of the region of country to which they present, at a slight excess of expense, the most eligible and the safest channel for its immense commerce in merchandize and domestic products. The steamboats now in commission on the western waters number nearly four hundred, about one-fourth of which are owned at, and regularly trade to the Pittsburg district. They are of all classes, adapted to the navigation of all the rivers tributary to the Mississippi; and it is the constant practice of their enterprising owners to send them freighted from

Pittsburg to the remotest accessible ports on the Missouri, Mississippi, Illinois, Arkansas, Wabash, Tennessee, Cumberland, Green, Kentucky, Red and Kenhawa rivers. It is very common, indeed, for boats to go full freighted to Independence, on the Missouri, Galena, on the Mississippi, or Peoria, on the Illinois; and, when the condition of the river is favorable, the freight for the whole distance of eighteen to twenty-five hundred miles rarely exceeds seventy-five cents per hundred pounds, and does not generally average over forty cents to St. Louis."

"The reasonable and equitable rates of transportation, which ought, under some regulation, to prevail on the Pennsylvania improvements, would at once render all these great valleys tributary, and all these steam vessels auxiliary to the complete success of our system of improvements. And thus we should subserve all the purposes of their original construction, enrich the public coffers—establish on a firm basis the commercial and manufacturing prosperity of Philadelphia and Pittsburg, and diffuse benefits and blessings throughout the Commonwealth."

"It seems not only proper, but *necessary*, under these circumstances, that some mutual understanding should take place between the carriers and the State authorities, predicated on a just and equitable revision of the tolls; an abatement of the evils of the present carrying system; and such a reduction of the rates of freight by the several transporters as will render it the *interest* of the business community to adopt the Pennsylvania line, as the *cheapest* as well as the *shortest* and *best route*."

"In order to effect this, the rates of freight must be *fixed* and *permanent*. At least certain *maximum* rates should be at once agreed upon and extensively made public as early as possible; and these rates should be so low as to make the route as cheap at least as any other, for all produce passing eastward, and all merchandize passing westward, *from the commencement to the end of every season*."

"It is confidently believed, and the opinion is corroborated by the most intelligent and experienced traders and merchants, that the result of all this would be, an ample supply of tonnage for the full and constant employment of all the stock now owned on the canals and railways within this Commonwealth."

"As the Pennsylvania canals are opened from four to six weeks earlier than those of New York, we may reasonably suppose that portable boats would be built and used on the Ohio canal. They could be loaded there, make a trip to Philadelphia and *back* again before the New York canals would open. And is it not likely that much of the produce that passes on the Ohio canal to Cleveland, and there awaits the breaking up of the lakes, would be sent to

Philadelphia if boats *could* pass directly from that canal through ours to Philadelphia? And if such diversion of produce could be made, the merchandize for the region whence that produce is sent, would of course, be purchased at Philadelphia, and furnish a return cargo for that description of boats. Every change like this in favor of our route, not only enures to the benefit of the route itself, but incidentally it conduces to the commercial prosperity of all cities and towns *from*, *through*, and to which such goods and products are passed."

"Another subject requiring the attention of the Legislature, which has heretofore been urged by the canal Commissioners without effect, is the carrying of passengers on our State railroads. One of the principal sources of profit on all railways in this country, and, we may add, in all countries, is the fare accruing from carrying passengers. Indeed, it has been a matter of surprise that the State should so long have neglected to avail herself of advantages to which she is fairly entitled, and which would tend so certainly to enrich her impoverished coffers. The Commonwealth should at once put on her own passenger cars, and transport all passengers on the Columbia and Philadelpha and Portage railroads; which can be done at a very trifling expense—the cost of cars being the principal aditional expenditure required. The State agents who are now employed to count the passengers could, under proper regulations collect the fare, and the number of officers would therefore not be greater than at present; while the receipts on the Columbia railroad would thereby be increased more than $50,000, and on the Portage railroad more than $10,000 per annum. At present, the owners of the several lines of passenger cars, on an expenditure of a few thousand dollars, in all not amounting to more than $30,000 of a permanent investment, realize a clear profit of a much larger sum than is made by the State on an investment of millions. This should be corrected, and the canal Commissioners earnestly call upon the Legislature to take this subject into consideration, and make immediate provisions by law for remedying the evil."

"The distances and maximum gradients of the railroads now rapidly approaching completion, both to the north and to the south of our State, and stretching out their iron arms to draw the wealth of the far west to the cities of Boston, New York and Baltimore, will exhibit, when compared with the routes brought to light by the surveys of the last two seasons, more clearly than anything the Board can state, the advantages which nature has bestowed upon Pennsylvania in making her the channel through which must eventually pass the greatest portion of the vast productions of the west."

"The following table was prepared by the Engineer from data which will be found in his report:

Railroad routes from the seaboard to Lake Erie.	Maximum grade in feet per mile.	Miles to Cleveland.	Miles to Erie.	Miles to Dunkirk.	Miles to Buffalo.
From Boston, via the Massachusetts railroads, and the railroads from Albany to Buffalo - - - -	80	731	611	561	521
From New York, via the Hudson river, and the New York and Erie railroad to Dunkirk	60	640	520	470	510
From New York, via the proposed New York and Albany railroad, and the railroads from Albany to Buffalo -	55	677.71	557.71	507.71	467.71
From New York, via the New Jersey and Philadelphia and Harrisburg railroads, and the proposed railroads from Harrisburg to Pittsburg, (by the middle route,) and from Pittsburg to Cleveland -	45	552	672	722	762
From Baltimore, via Baltimore and Ohio railroad to Pittsburg, and the proposed railroad from Pittsburg to Cleveland - - -	84	467	587	637	677
From Philadelphia, via Philadelphia and Harrisburg railroad, and the proposed railroads from Harrisburg to Pittsburg, (by the middle route,) and from Pittsburg to Cleveland - - -	45	467	587	637	677
From Philadelphia, via Philadelphia and Harrisburg railroad, middle route to Conemaugh, thence via Freeport and Meadville to Erie -	52.80	585	465	515	555
From Philadelphia, via Reading, Little Schuylkill, Catawissa, and Sunbury and Erie railroads to Erie -	60	555	435	485	525

NOTE.—From each port on Lake Erie where the railroad lines terminate, to the port to which the distance is marked in the table, the distance has been taken by the lake."

[For the American Railroad Journal and Mechanics' Magazine.]

MESSRS. EDITORS: I perceive that Mr. Ellet's recent pamphlet on "The Causes of the Failure of many Railroads" has induced some criticism in your valuable Journal; in these strictures it appears to the writer that Mr. Ellet's views have been essentially misapprehended; for instance, in your February number, you state Mr. Ellet's case thus:

"That the strength of the road, and consequently its cost,—the weight and power of the engines, and the weight and strength of the cars, are to be *in exact proportion to the amount of trade.*"

Now if you had added to this sentence the words, "*which it is found may reasonably be anticipated,*" the case would have been more fairly put, and your criticism would have lost its gist.

To show the importance of the addendum suggested, in order to develope fairly the views of Mr. Ellet, if you will be good enough to turn to page 4 of his pamphlet, you will find the following interrogatory put by him as expressive of his sentiments, viz.:

"What should be the location and character of the road, and the character of its furniture, for the economical accommodation of the trade *which it is found may reasonably be anticipated!*"

You will at once perceive, Messrs. Editors, that this changes materially the face of the question, and renders the most of your strictures entirely inapplicable.

What does Mr. Ellet suggest as a guide for the construction of future works? Nothing more than is required by the time honored aphorism, "*that the means should be proportioned to the end,*" which is aptly illustrated by Mr. Ellet in the statement that, "The power contrived to drive a grist mill, would make but small dividends if applied to turn a churn."

In these ideas there is no novelty,—they are common sense doctrines, which meet an affirmative response in every bosom; and they were, twelve years ago, applied to this very subject, by Mr. Thomas Earle, in a treatise on railroads, published by him in Philadelphia, in 1830; he says on pages 31 and 32, after describing the inconveniences of several modes of forming a general plan to control the location of a railroad:

"Which of these inconveniences is to be preferred, will depend very much on the nature of the country and *the amount of transportation which can safely be expected,* and will therefore be a subject of calculation *in each particular case,* requiring much skill and care in the engineer."

"Where the amount of tonnage will be very great, it may be true economy to expend a sum in straightening the road and avoiding acclivities, which would be *absolute extravagance* where the transportation will be small in quantity; *for each ton of goods should pay its share of the expenditure, and the shares will be greater or less, according to the number of tons passing.*"

Though Mr. Earle is not an engineer, it would, nevertheless, have proved of vast utility to the community, if the projectors of some of the existing railways, had attended more closely to the judicious admonitions which he spread before them, as long since as 1830, in the paragraphs which we have quoted, and others of the same tenor to be found in his book referred to; and which are now revived in a more imposing form by Mr. Ellet, sustained as he is, *by the experience since that time.*

Touching the question of the best speed for freight trains on railroads, the writer would ask your attention to the experiments of Mr. Edward Woods and others, as a committee of the Institution of Civil Engineers on "railway constants," you will there observe that these gentlemen found that *the minimum resistance of trains on railways* took place when the speed was *six miles per hour*, (the same proposed by Mr. Ellet,) and consequently such a pace would be *the cheapest*, and of course for many kinds of freight *the best* that could be used *for the burden trains.*

Z.

[From the Civil Engineer and Architect's Journal.]

REMARKS ON SHIPS OF WOOD AND IRON.

Remarks on the relative advantages of the employment of wood and iron in the construction of ships have appeared at different times, in jounals devoted to inquiries relating to subjects of this nature, but a spirit of partizanship has been commonly displayed by the respective advocates of wood and iron in favour of their own views. In an endeavor to avoid this charge, it will be expedient to advert in the first instance, to the different modes in which wood can be employed in ship building, especially as the advocates of iron are in the habit of referring to the defects of ships built of timber, which are capable of being obviated by a different system of constuction.

The relative merits of wood and iron for this purpose will, I apprehend, come more fairly before the public by an exposition of some of the plans that may be adopted in the construction of ships of wood; and it appears to me that three well marked systems may be distinguished. 1st. The common plan of timbers, whether framed or single, separated by spaces from each other, whose principal connection with each other, arises from an external and internal series of planking. 2d. The plan used in her Majesty's dock yards, of timbers wedged up solid, and covered by an external planking, (timbers placed close together, I conceive would be found to be a better method.) 3d. A plan of constructing vessels of any size by two or more connected series of planks without timbers; this method has not been extensively used. Clinker built boats belong to this third system, and perhaps also iron vessels, inasmuch as the plates of iron of which they are formed are of far more importance than the iron ribs, which occupy the position of timbers.

The advocates of iron have, I apprehend, by no means exaggerated the defects of ships of the common construction, in which the connection of the timbers with each other is extremely imperfect, even in the best built merchant ships, and the safety of the largest vessels is dependant on the security of the butts of 4-inch plank.

I consider these defects are so fatal that no increase of strength or improvement in workmanship can more than palliate them in a greater or less degree, and I propose to abandon any reference to these vessels, and at once admit their inferiority to vessels constructed of iron, provided the latter are made of sufficient strength.

A large proportion, however, of the present enormous annual loss of merchant ships seems to have been sufficiently traced to defective methods of construction, and to the facility it affords in converting the defects of cheap ships; still the cause that tend to foster the continuance of the present system are subjects foreign to the tenor of these remarks; the fact that the rottenness of the timbers can be concealed from casual inspection, is sufficient for our purposes. It has been urged that unless spaces are provided between the timbers, for the accommodation of water from leaks, that it would rise in the vessel and spoil the cargo. This argument is founded on the assumed necessity of leaks, but it affords proof of their frequent occurrence in vessels of the usual construction.

The rapid destruction of timber by the united operations of wet, heat and filth, and the generation of foul air from these causes will not be denied; and in addition to its weakness the rapid deterioration of the frame of the vessel, from the above causes, seems an equally fatal objection,—though exceptions may occur, owing either to care or accidental conditions.

The second system of ship building with timbers wedged up solid, has been in use for a considerable period for ships of war, and the success that has attended this plan has been amply proved by the accounts of the escape of different vessels, that have since its adoption been driven ashore and got off again, in many instances without injury, and in other cases damaged to such an extent as would have insured the total loss of vessels of the common construction; for instance, the *Pique* lost a large portion of her keel, and in some places the whole of the starboard streak, and a part of the floor timbers were ground away by the rocks of Newfoundland, and yet this frigate crossed the Atlantic without a rudder, under circumstances, it must be admitted, of some anxiety to the officers and crew.

For merchant ships I should propose to use the same weight of materials as are now employed, the outside planking would remain without alteration, but the quantity of wood in the ceiling would be added to the width of the timbers, and in case it was insufficient to fill up the spaces between the timbers, the depth of the latter must be lessened to make up the deficiency.

Under these circumstances the timbers would be about double the thickness of the outside planks, and being placed close together, a good means of connection might be obtained by large dowell or coaks, so as to produce a mutual dependence on each other, and so that any pressure on the outside would exert a more regular strain on every part. A vessel constructed on this principle would be an irregular cask, and when caulked inside and outside would float without planking; and by the addition of the latter, a frame of great stiffness, and equal strength and thickness in every part would be obtained, on which one side of every piece of wood used in its construction would be visible, and would allow an examination to be made of its state with great facility. The other sides of the wood would be preserved from wet as long as the fabric of the vessel remained sound, and the caulking was attended to. It is obvious that a greater inside width of 7 or 8 inches would be gained in these vessels, and no loss of space would accrue if it was occupied by battens to admit of water accommodation for the leakage, and the prevention of injury to the cargo from the escape, until at least the present advocates of the assumed necessity of leaks in ships, became convinced of the small prospect of their occurrence under common circumstances in vessels so constructed.

It is true no provision will afford security to vessels on rocks among breakers, but such situations afford the best test of the merits of different systems of ship building, by the time each vessel is found capable of resisting these effects.

Numerous cases will occur where life is dependent on the time the vessel holds together, but the partial saving of the cargo may be considered objectionable by ship owners, among whom the advantages of a total loss are well understood. Opinions on these points are of little value, we must wait for evidence from wrecks under different conditions.

The scantling proposed for merchant ships would, I apprehend, be not quite so heavy as that in use for ships of war of equal size; at the same time, it is probable that the strength of timbers placed close together, except that of the dockyard plan of timbers wedged up, to such an extent that a greater strength may be perhaps obtained at a smaller cost. Plans of this nature are obviously only suited for good workmanship and good materials; but it ought to suit, for less insurance premiums, whenever an inquiry on this subject is properly conducted, and explanations are afforded to insurers of such a nature, as shall be fully understood.

The third plan referred to, requires similar conditions of timber and workmanship, but it has not been extensively adopted. Ten or twelve series of inch planks were employed many years ago, in a 500 ton vessel built at Rochester, but I conceive three or four series of 2½ to four inch plank, according to the size of the vessel, would be found a more convenient method of construction.

Several of the Gravesend steamers of 150 feet in length have been built of three series of 1½ inch planks, and they have run for 4 or 5 years, and are now said to be as sound as when first constructed, such at least was the case with the Ruby, when opened for the purpose of lengthening the bow to increase her speed.

This method however requires farther trial, especially at sea, before any decisive opinion can be given on its comparative merit; it is favorable to soundness, as the necessity of sawing the wood into planks admits of the certain selection of good materials, and would afford great facility in seasoning timber properly. While the expense of selection would in some degree be lessened by the conversion of the rejected planks to inferior purposes, or by working it up in inferior or cheap craft, perhaps for river use. The increase of cost would not answer unless it was accompanied by a proportional increase of durability, and perhaps the general opinion would be in favor of the latter result, as a necessary consequence of the selection of good timber.

The launches used in the navy have for several years been made on Johns' plan, of two series of planks crossed diagonally, their weight is about ⅘ of the boats of the old construction, and their durability has been much increased. The Gravesend steamers are built with two similar series of crossed planks in lieu of timbers, covered with an outside planking in the common mode, the whole well fastened with copper,—in large vessels perhaps a ceiling connected in the same manner might be deemed advisable: at the same time it seems probable that a greater strength would be obtained by a less quantity of timber in the third than in the second method of construction proposed. Clinker built which belong to this class, in which the principal strength depends on the planking instead of the timbers, seldom exceed 100 tons in size, and are usually of a slight scantling; their great durability is well ascertained, provided they are kept from the ground, in which case from the thinness of the single part of the planking, holes are easily knocked in their bottoms.

The introduction of these methods of constructing timber ships is not likely to be effected, except by the nearly total destruction of the present trade in ship building, by the more general adoption of iron vessels, and the interest of humanity will cause the earliest occurrence of this result not to be regretted. Nothing perhaps but the severe pressure of iron competition will induce the present race of ship builders to turn their attention to the means whereby greater strength, security and durability may be given to wooden ships; eventually perhaps its greater strength for a given weight, and its greater elasticity may obtain a preference.

Prime cost undoubtedly will form a principal element in the approaching competition; at present iron vessels are often built too cheap, or in other words too slight; the error may be, and I believe has been remedied. Innumerable questions will arise relating to the elasticity, strength and durability of wood, as well as its quality; and also in reference to the destructive action of salt water on iron, the strain on the rivets, etc. etc., which can only be answered by experience.

To a spirited competition between wood and iron, I look for the improvement of vessels of both materials. Recently I have met with parties who being engaged simply as owners on the proposed construction of a steamboat, in consequence of the difficulty in the choice of wood or iron, have found it necessary to institute an inquiry respecting their relative merits in ship building; these parties, but for the difficulty of selection, would have gone on in the good old jog-trot way of supposing that British ships of the old construction were perfect specimens of the art, and would have patiently submitted to the present rates of insurance, as founded on the average loss, deduced from defective ships. The spirit of inquiry once aroused among owners of shipping, will I trust lead to results as yet scarcely anticipated.

It matters little to the country whether wood or iron eventually obtains the preference; if British iron, and the inhabitants of our land ought to be satisfied if the latter will uphold the character of the navy as well as the former has done.

At present I consider the question of relative superiority as undecided, and though disposed to admit the inferiority of timber vessels of the common construction, yet the advantages of iron may not exceed that due either to the methods of construction adopted in the navy, or in the Gravesend steamboats. The latter method is perhaps best adapted for small, and the former for large vessels. Moreover, we want the evidence likely to be afforded by the wreck of the largest iron steamers, for the formation of an opinion respecting their powers of endurance under the breakers of a rocky shore or a sand bank.

In regard to the relative advantages of the two plans of ship building proposed for the merchant service, the method adopted in the navy has received the stamp of experience, and the evidence is conclusive in its favor. The 500 ton vessel built of planks before alluded to, was driven on shore in a heavy gale under Mount Batten, in Plymouth sound, when loaded with ordnance stores, in company with 10 or 11 other vessels, all of which became total wrecks; she afforded an almost solitary instance of a vessel saved, when ashore on that point, and she is reported to have rebounded from the rocks for a short time like a cask, until a hole was knocked in her bottom; after the gale she was got off, and was repaired at a moderate expense, and proceeded on her voyage to the East Indies.

I should also be inclined to the opinion that a greater strength will be obtained with a less quantity of materials, by means of several series of planks than by close timbers and outside planking, but the latter plan seems to afford greater facility for repairs. In conclusion, I would remark that it is my object to assert the possibility of the introduction of great improvements in the construction of vessels of wood, without an increase, and perhaps at some reduction of cost, and I wish to induce parties engaged in ship building to advert to the fact, that the best portion of their business, the construction of steamers, is rapidly passing out of their hands, and that unless sailing vessels are rendered stronger, safer and perhaps lighter, this portion of their trade may follow, as the establishments for building iron vessels are increased, or at least such a depreciation of prices may occur as will be equally ruinous to them.

At the same time I must acknowledge that great improvements in regard to strength have been necessary, and have been adopted in many of the larger steamers, in some instances perhaps to the full extent here advocated, at least in the engine room; similar principles might be adopted in the fore and after bodies with lighter timbers, and hence a less strain would be thrown on the midship body in passing over heavy seas. It is their general adoption that I would urge, and I cannot but express my conviction that steamships of the largest class yet made, may be constructed to bear the winter seas of the Atlantic, by a better disposition of the timber employed in their construction.

HARRISBURG AND PITTSBURG RAILROAD.

The contemplated Harrisburg and Pittsburg railroad has for its immediate object the connection of these two points, but it should also be considered as the main link of a contemplated railway communication between Philadelphia and St. Louis, with branches to Cleveland, Cincinnati, and other central points. Viewing it in this light, we are astonished at the great indifference evinced by the citizens of Philadelphia, to a plan which should be entitled to their highest consideration, as involving to a great extent the question of their future commercial prosperity.

A perusal of the last report on the New York and Erie railroad, has convinced us that the merchants and capitalists of New York have become awake to the great importance of an uninterrupted communication with the lakes. It appears they have been aroused by the vigorous efforts of the Bostonians, who have already accomplished a continuous line of railroad from their city to the lakes, which with the aid of Cunard's steamers forms a direct communication between the valley of the Mississippi and Europe.

While we were involving ourselves in bankruptcy by insane bank operations our wise neighbors in the east were looking ahead, and discovered that the investment of eleven millions of capital, in the construction of a road to Albany, would be the best "regulator" of their future commercial transactions, and doubtless it will prove a mighty "balance wheel" always working in their favor. Baltimore as well as New York is emulating the example of Boston, and their citizens are exerting all their energies to finish the Baltimore and Ohio railroad to Pittsburg.

The question naturally arises, what will become of the commerce and travel of Pennsylvania, and especially in what condition will Philadelphia find itself on the completion of the Boston and Albany line, the New York and Erie, and the Baltimore and Ohio line? We answer, it will operate so powerfully upon the interests of Philadelphia, that its property will at once depreciate and its population decline. Our friends in the city may rejoice that their future prosperity depends upon the developement of the mineral resources of the State, and that they must devote their energies to manufacturing. Very true, to a certain extent, and we wish you success with all our heart. But let us remember that the Pennsylvania canal has been mainly conducive to the present greatness of Philadelphia and Pittsburg, by facilitating the transportation of goods and passengers. It is no exageration that our canals have raised the value of the two cities at least $60,000,000. But as they are locked up in winter and do not answer the purpose of travelling, you want in addition a continuous railroad which with your other resources will place your future business above competition.

We have always been a steady advocate of a judicious improvement system, and are not willing to abandon it now, when it is forsaken by many of its former friends. Undoubtedly the system was commenced on a scale too extensive for the immediate wants of the country, and we have to bear the consequences of this error and be on our guard for the future. But yet Pennsylvania is much better off with her present debt and improvements than without them. The apparent failure of these improvements has turned the tide of public opinion against the whole system, the innocent suffer with the guilty, and railroads along with the rest have sunk in public estimation.

In our opinion, there is no State in the Union in which railroads should be more advocated than in Pennsylvania. The vast sums transmitted to England for railroad iron, have gorged the coffers of the nabobs of Wales, leaving us in debt to a vast amount. How much better would be our condition if this railroad iron had been procured from our own mines and rolling mills. And we are yet in hopes that common sense enough will be found in the country, to arrest the sending of our specie to Europe, to procure a material which abounds in our own soil in the gratest profusion. Suppose a protective tariff should prohibit a further importation of railroad iron, what a source of revenue would arise to Pennsylvania from the construction of railroads in other States? In a few years railway stocks will rank highest in the stock market, and why should not judiciously constructed railroads, which accomodate a large and regular business and yield dividends of from ten to twenty per cent., be more than equivalent in value to real estate? And among all routes the Philadelphia and Pittsburg line must from the nature of things, become one of the most productive roads in the Union.

After the three great railway lines, now being constructed between the borders of the Atlantic and the valley of the Mississippi, have been completed and in operation for some years, the greater part of the travel and business of Philadelphia will be diverted, and that city will find herself placed in a dilemma from which she can only extricate herself by the speedy construction of a railway of her own. The question then arrises, how is such a desirable object to be effected; is there a practical route through Pennsylvania, able to compete with the other rival lines, and is there a reasonable prospect that the capital expended on such a work would prove a good investment? To these inquiries we can return the most satisfactory answers. But let us first dwell upon the comparative merits of the

Pennsylvania route. It will be reserved for a future article to show beyond a doubt that investments in this road would in less than ten years prove the best railroad stock in the country.

Many of our citizens are not aware of the fact now established by the Harrisburg and Pittsburg railroad survey, that our own State possesses the best and shortest route for a railway between tide and the Ohio river and the lakes, and that this route is so much superior to all the other routes, that it will, if constructed in season and ably managed, become the great thoroughfare between the east and west.

The survey for a continuous railroad from Harrisburg to Pittsburg, authorized by the legislature three years since, is now completed. Very fortunately this important task was entrusted to Charles L. Schlatter, Esq., as principal engineer, to whose talent, sound judgment, and unwearied industry, we are indebted for the happy result. We refer to the second report of this gentleman, where the distance by the so called middle route from Philadelphia to Pittsburg is stated at 348 miles. We have been informed that he has since succeeded in effecting a reduction of distance of 11 miles between Jack's narrows at the forks of the Kishacoquillas creek and Dorsey's forge at the gap of the litle Juniata through Tussey's mountain, by resorting to a tunnel through Stone mountain. Being well acquainted with that region, we consider it a just tribute due to the engineer, to state that he has, in our opinion, by the location of the line, evinced a high degree of professional skill. When this road is constructed, the Stone mountain line will be looked on as a proof, how difficult formations of the ground, and obstacles apparently insurmountable, can be overcome if throughly examined by a competent engineer.

The total distance from Philadelphia to Pittsburg is therefore now reduced to 337 miles, and with no gradients exceeding 45 feet per mile. The distance from Baltimore to Pittsburg, by the Baltimore and Ohio railroad, is about the same, but we believe there are grades on that route of 66 feet per mile, and even one of 84 feet per mile. This rival line appears therefore much inferior to the Pennsylvania route, and will not draw any business from Philadelphia by superior facilities of transportation. In his comparrison between the Pennsylvania and New York routes, Mr. Schlatter has assumed Cleveland as the most suitable point of termination in the west.

The distance from Philadelphia to Cleveland, via New York and Erie railroad, and lake, is	640 miles
The distance from Philadelphia to Cleveland, via Pittsburg, - - - - -	467 "
Difference of distance in favor of Philadelphia,	173 "

Besides this great difference of distance, we must observe, that the maximum gradients upon the New York and Erie railroad rise as high as 60 feet per mile. As the distance from New York to Cleveland, via Philadelphia and Pittsburg, is 88 miles shorter than by the New York route, and as the grades on the former are more favorable and no danger from the lake navigation, the merchants of New York will prefer sending their goods by the Pennsylvania route.

The distance from Boston to Cleveland, via the Western railroad, is 728 miles, therefore 261 miles further than from Philadelphia to Cleveland. The gradients on that road are also less favorable than on the Pennsylvania route.

Owing to the mixed nature of our present line of improvements, we shall never be able to compete with New York in the transportation of heavy freight while the Erie canal is open. The low stage of the Ohio river during a part of the summer season, also diverts much of the western trade from the Pennsylvania channel, and sends it through Ohio and New York. But by constructing the Harrisburg and Pittsburg railroad, and extending it to Cleveland, Philadelphia will at once monopolize the winter and spring business, and nearly the whole of the travel beyond competition.

There is certainly cause of congratulating the city of Philadelphia on such fair prospects, and well does she need it in her present gloomy situation. We may be told by some that it is quite out of time to talk of new improvements, but we do not coincide with such opinions. This is the very moment to offer some consoling reflection, some bright prospect for the future, no matter how distant. We do not promise the immediate formation of a company for commencing the line in question, but we most earnestly advise all those who have the future prosperity of Pennsylvania and especially of the city of Philadelphia at heart, never to lose sight of the fact that Pennsylvania has the best railway route between the Atlantic and the valley of the Mississippi, and that such a work should be commenced as soon as our means and credit are sufficiently restored. We should not allow our neighbors of the east and south to indulge in the prospect gradually absorbing our interests; we should understand our own position, define it clearly before the public, and determine to avail ourselves of it at as early a period as possible. We are conscious we are advocating a measure which richly deserves it, and which promises a fair result, if attended to in season.

The rapid strides of improvements in steam navigation on the ocean, clearly show that our shipping is undergoing a radical change. There is no doubt the consumption of fuel in steam navigation will shortly be reduced to the minimum the nature of steam will admit, which has long been attained in the Cornish engines. No good reason can be assigned, why the difficulties attending upon the expansive use of high steam in navigation, should not be removed in a very few years. This once accomplished, steam ships will multiply, and Philadelphia no doubt will soon own a large interest in this species of navigation, and her ships will be moving in all directions, propelled by our anthracite coal. With the aid of her steamers and the most direct railway communication with the west, Philadelphia may again resume her former proud position among her sister cities.

But let us not forget the ways and means by which such desirable objects are to be accomplished. The Harrisburg and Pittsburg railroad, which has given origin to the above remarks, is to be considered as the first step towards re-establishing her former supremacy.

Let us look upon the money appropriated by the State for the Harrisburg and Pittsburg railroad survey as well expended. The knowledge of the fact that Pennsylvania possesses such a favorable route, enhances the value of the whole State.

We conclude this article by congratulating the public upon the happy result of these surveys, and as we feel more than a common interest in this matter, we cannot take leave of it, without paying a well deserved compliment to the talented engineer, Mr. Schlatter, for his successful labors, and we heartly wish that those who control our public improvements may be farther disposed to avail themselves of his valuable services.—*Pennsylvania Reporter.*

[From the Civil Engineer and Architect's Journal.]

ENGINEERING WORKS OF THE ANCIENTS.

The Greeks.—The silver mines of Attica (book 9, chapter 1,) were formerly very productive, they are now exhausted. When they still produced a slight return for the labor of the miners, they melted up the old rubbish and scoriæ, and a considerable quantity of very pure silver was obtained from them, seeing that the ancients were not very skillful in the art of extracting metal. A commentator remarks on this passage that it is a proof of the progress of mining in this age, but that even then the Romans had by no means gone to the extent of modern art, as sufficient is still sometimes found in Romish scoriæ to pay for the expense of extraction. He farther observes that the mines of Laurium showed signs of exhaustion in the time of Socrates (Xenophon Memorabilia, book 3, chapter 6, § 12.)

In the next page Strabo notices a bridge over the Cephissus.

In book 9, chapter 2, our author gives a description of the works on the Euripus, but one which is very inaccurate.

Speaking of the plains of Beotia opposite to Eubea (book 9, chapter 2,) an account is given of the works undertaken to drain them, by a contractor for works, of the name of Crates of Chalcis. He was obstructed by the factions among the Beotians, but in a report, addressed by him to Alexander, he relates that he had already drained several large tracts. This contractor is also mentioned by Diogenes Laertius, book 4, § 23, as being employed by Alexander.

In book 10, chapter 1, is an obscure passage relative to the mines of Chalcis.

In the same, chapter 3, Strabo refers to the labors of Hercules on the Achelous.

The Rhodians as well as the Cyzicans and Marseillese were famous as military engineers, (book 14, chapter 2.)

Cilicia.—Book 12, chapter 1, contains an account of the mode in which King Ariarathes the 10th stopped up the Malas, a feeder of the Euphrates, and how the dike having burst and caused injury to the neighboring lands, the king was fined 300 talents by the Romans.

Pontus.—Chapter 2d of the same book describes the mode of working the mines of Sandaracurgium.

Ephesus.—The entrance of the port of Ephesus is too narrow, the fault of the architects and engineers, who were led into error by the king, who employed them on this work. This prince, who was Attalus 2d, Philadelphus, king of Pergamus, seeing that the port was being silted up with banks from the deposits of the Cayster, and thinking that it could be made deep enough to receive large vessels, if a mole were thrown before the entrance which was too broad, ordered the construction of the mole. The contrary however happened, for the mud filled the port with shoals as far as the entrance, whereas before, the deposit was sufficiently carried out by inundations, and by the reciprocal movement of the waters of the outer sea. Such are the defects of the port of Ephesus (book 14, chapter 1.)

Persia etc.—Alexander in his expedition to Gedrosia was preceded by miners to search for water, (book 15, chapter 1.)

In book 15, chapter 3, a bridge is mentioned as being thrown over the Choaspes at Susa.

In the next page sluices are mentioned on the Tigris.

In book 16, chapter 1, an enumeration is made of the works of Semiramis.

Alexander destroyed a number of sluices on the river Tigris. He also occupied himself with the canals, which are of the greatest importance to the agriculture of that country (B. 16, chapter 1,) a theme upon which our author dwells at some length. He relates, on the authority of Aristobulus (see also Arrian, B. 7, § 22,) that Alexander seated in a boat steered by himself, attentively surveyed the canals, and caused them to be cleaned by employing a great multitude of men, whom he took with him. He also had certain outlets closed and new ones opened. He remarked a canal, principally leading to the lakes and marshes on the Arabian side, and the outlet of which, on account of the softness of the ground, could not easily be closed; he therefore opened a new canal or mouth about 30 stades off, in a rocky ground, through which he turned the waters.

Egypt.—In his 17th book, Strabo describes Egypt. He mentions the skill the Egyptians showed in hydraulic works, but the fact upon which he dwells is partly perhaps attributable to Roman science. He says that before the time of C. Petronius (chapter 1) Governor, A. D. 20, that the greatest inundation and most abundant harvest took place when the Nile reached fourteen cubits, but that under the administration of that governor an inundation of twelve cubits produced abundance.

In that book and chapter there is frequent mention of canals and there is a description of the canal of the Red sea. (See also Diodorus Siculus, B. 1, § 19 and 33.)

Here also Strabo describes the Egyptian mortar as being made of pounded basalt, brought from the mountains of Ethiopia.

Pausanias—Ælian and Appian.—In Pausanias the only notices in any way relating to our subject are an allusion to the silver mines of Laurium in the commencement of the Attics, and in the Laconics a statement that Eurotas diverted the river. Ælian and Appian there is nothing except perhaps that the latter, in the account of the siege of Carthage, mentions a cut made through the harbor by the Carthaginians.

Arrian.—Arrian in his life of Alexander, 7th book, chapter 21st, gives a better account than Strabo of Alexander's repair of the canal called Pallacopas, although this latter account differs, we shall content ourselves with a reference to it. We may observe that Gronovius has annexed to his edition of Arrian a small treatise on this canal, which embodies all the account and modern information respecting it.

In his second book Arrian devotes much space to the siege of Tyre, from which we shall extract some of his remarks on the mole. He says that the sea there, has a clay bottom, and shallow towards the shore; but when you draw near the city, it is almost three fathoms deep. As there was abundance of stone not far off, and a sufficient quantity of timber and rubbish to fill up the vacant spaces, they found no great difficulty in laying the foundations of their own rampart; the stiff clay at the bottom, by its own nature, serving instead of mortar, to bind the stones together. The Macedonians showed a wonderful forwardness and alacrity to the work, and Alexander's presence contributed not a little thereto; for he designed every thing himself, and saw every thing done. In describing the subsequent operations Arrian says that many engineers, meaning military engineers, were brought from Cyprus and Phenicia.

In the fifth book a long account is given of the mode adopted by the Romans, and particularly by the old Romans, in forming temporary bridges for crossing large rivers.

CAPACITY OF THE CHESAPEAKE AND OHIO CANAL.

Some persons, says the Baltimore Patriot, have doubted whether this canal will have capacity to pass the freight adequate to pay an interest on the outlay for the work. To such, it is well, at this time, to give reference to a part of the report of the company, made to the stockholders in August, 1839. The passage is as follows, and it certainly shows, on the most authentic data, the abundant ability of the canal, when finished, to accommodate freight far beyond the amount of interest on the cost of the work. (The quotation is from page 27 of the report.)

1. *As to the capacity of the canal.*—On canals of four feet depth, with locks of fifteen feet wide and ninety feet long, it seems to be ascertained that the most economical medium of navigation is a boat carrying fifty tons. The depth of the Chesapeake and Ohio canal being six feet, the dimensions of its locks being 15 feet in width by 100 in length, it is supposed that boats of 80 tons will be best adapted to its use. Much larger loads may be readily trans-

ported; but we have assumed that of 80 tons as, in general, the most convenient and economical. The navigation on this canal, judging from actual experience and observation, will exceed rather than fall short of 300 days in the year. The longest season of navigation on the Erie canal, for the fourteen years preceding 1837 inclusive, was 269 days; the shortest, during the same period, was 216 days. In the year 1835, of 230 days' navigation, 25,798 boats and rafts passed through one of its locks in the two directions. In 1836, of 216 days' navigation, 25,516 boats, etc. passed. The average of these two years would be equivalent to 34,516 boats, etc. for a year of navigation of 300 days.

The largest number of boats, etc., which have passed on the Erie canal, during the same period of 14 years, in any one month, was, in October, 1835, viz 4,215; that is, 136 per day; which is equivalent to 40,800 for a year of 300 days.

The greatest number of boats which have passed in one day through a lock on the Erie canal, so far as we have any official statement on the subject, is 302. At this rate, the year of navigation of 300 days would be 90,600.

The locks upon the Erie canal are single, as are at present those on the Chesapeake and Ohio canal. The latter, however, have all been constructed with a view to double lockage, when the exigencies of the company require it. The intelligent officers of the Erie canal, who have furnished the foregoing statements, concur in the opinion that the double locks would increase the facilities to the extent of two-thirds. The opinion is also distinctly expressed, that, although under very favorable circumstances 302 boats have passed in a single day, 250 may be taken as the number which may conveniently be passed.

From these data, derived from a long experience, we are led to these results:

	Single locks.	Double locks. (Two-thirds increase.)
1. Boats etc. which have actually passed, in 1835, in 230 days, as above - -	25,798	42,996
2. Do. do. in 1836, in 216 days - -	25,516	42,526
3. Assuming 300 days of navigation for the year, and the average of the two years above would be - - -	34,516	57,526
4. Assuming the same year of 300 days, and the rate of the greatest month's work would be - - - -	40,800	68,000
5. Do. do., assuming the rate of the greatest day's work as above, 302 -	90,600	151,000
6. Do. do. do., assuming the rate, which it is represented, as above, may be safely estimated for a day's work, 250 -	75,000	125,000

Estimating the boat load at 80 tons, the amount transportable, according to the foregoing table, number 4, would be, with single locks, 3,264,800 tons; and with double locks 5,440,532 tons. In like manner, estimating the load at 80 tons, and applying it to the sixth item in the foregoing table, the result would be with single locks 600,000, and with double locks 1,000,000 tons per annum.

According to the present tariff, the toll upon coal, which is the lowest article, amounts to one dollar per ton from Cumberland to Gorgetown; and supposing one-half of the tonage in the last preceding statement to be descending coal, that there should be no ascending trade, and the boats always return empty, the amount of tolls, upon the first of the above statements, would amount to $1,634,-400 per annum with single locks and $2,720,266 with double locks.

Apply the same ratio of calculation to the second estimate, and the result would be $3,000,000 with single, and $5,000,000 with double lockage. Each individual may judge for himself of the probability of the data upon which the foregoing estimates have been formed, and vary the results accordingly.

A. B.

Note.—The present winter, (1841-'42,) the navigation of the Chesapeake and Ohio canal might have continued to the present time, (January 17th.) The navigation of the Erie canal was long since closed.

C. B. F.

National Intelligencer.

LOCOMOTIVE PERFORMANCE.

Mr. Editor: By the following statement of the power of locomotives, it would seem that the system of transporting freight by railroad has been brought to such perfection, that they may be fairly put on a par, as to econemy, with either canal or river transportation.

Philadelphia, *February* 12, 1842.

Messrs. Baldwin and Vail; Gentlemen,—I send you enclosed, a statement of the performance of your new six wheeled, geared engine, which you will perceive is in every way satisfactory. The train weighed 108½ tons, of 2,240 lbs., more than that hauled by your "Hichens and Harrison" engine in February last, on our road.

Statement of the performance of a six wheeled engine, built by Messrs. Baldwin and Vail. on the Philadelphia, Reading and Pottsville railroad, February 12, 1842.

This engine has six wheels and outside connections. The large drivers (44 inches in diameter,) are behind the fire box, and connected with the 4 truck wheels, (33 inches in diameter,) by cog gearing, in such a way as to obtain the adhesion of the whole weight of the engine, with little additional friction, and at the same time allow the requisite play in curves.

Her weight, in running order, is 30,000 lbs.; on her large drivers, 11,775 lbs.; or 5,887 lbs, on each; On the truck wheel 18,225 lbs. or 4,565 lbs. on each, and her cylinders are 13 inches diameter and 16 inches stroke.

This engine hauled, on the above date, a train of 117 loaded cars, weighing in all 590 tons, from Reading to the inclined plane, on the Columbia railroad, 54 miles, in 5 hours and 22 minutes, being at the rate of over 10 miles per hour the whole way.

She consumed $2\frac{6}{10}$ cords of wood, and evaporated 3,110 gallons of water, with the above train. Weight of freight, 375 tons, of 2,240 lbs.; consisting of 259 tons of coal, 22 tons of iron and nails, and 94 tons of sundry other merchandize, including 53 live hogs, 10 hhds. of whiskey, 188 bbls. flour, ship stuff, butter etc. Weight of cars, 215 tons, making a total weight, not including engine and tender, of 590 tons of 2,240 lbs.

Whole length of train, 1,402 feet, or 82 feet over a quarter of a mile. The above train was transported in the ordinary freight business of the road, and was run without any previous preparation of engines, cars or fuel for the performance. The engine was closely watched at all the starts of the train, and not the lest slipping of any of her wheels could be perceived. She worked remarkably well throughout the trip, turning curves of 819 feet radius, with ease to her machinery, and no perceptible increase of friction in her gearing. Her speed with the train on a level, was found to be 9 miles per hour.

Whole length of level, over which the above train was hauled, 28 miles; longest continuous level, $8\frac{1}{10}$ miles; total fall, from the point where the train was started to where it stopped. 210 feet.

The above train is unprecedented in length and weight, in Europe or America.

G. A. Nicholls,

Superintendent of transportation on the Philadelphia, Reading, and Pottsville railroad.

U. S. Gazette.

BITUMEN.

A new application of this material which promises to be of very great service in engineering works, has lately been successfully practised by the Parisian Bitumen company. The new application consists in cementing large masses of rubble stone with the bitumen in a liquid state, and this has been successfully practised on a very extensive scale on the works of the Upper Medway Navigation company in the following manner.

The river is divided into levels by weirs and locks in the usual manner. Some of those wiers are constructed at great expense of squared masonry; others are less expensively constructed, by throwing in the rubble stone of the country to the desired shape and height of the weir; it may be remarked that no care is taken in bedding the stones, or in laying them. which is performed by the ordinary laborers of the country. The bitumen is then melted and run in between the stones, and the whole forms a mass of such solidity as to resist the heaviest floods, and is perfectly impervious to water in every part, and it is supposed that it will not require one-tenth of the repairs usually bestowed on weirs of the ordinary construction.

It may be noticed that previous to this material being used, the repairs after the winter floods, which are very heavy, were very great, and caused considerable interruption to the traffic.

The great advantages arising from using the bitumen in the manner described are cheapness and facility of construction—a very considerable reduction in the expense of repairs. It is evident that this may be used to very great advantage in foundations of bridges or large buildings, as forming a compact body capable of resisting any pressure, bearing any weight that may be imposed on it, and becoming perfectly solid in five minutes after being laid; it will effectually prevent vermin from getting into houses or burrowing near the foundations.

The manufacture of bitumen is now brought to great perfection by the same company. Some beautiful specimens of tesselated pavement are being laid of different colored bitumen, and floors of stations, churches, halls, etc., may be made very ornamental, and equally durable with Yorkshire stone, while it is much warmer to the feet and not more than half the price.—*Civil Engineer and Architects Journal.*

Increase of Revenue on Railroads.—The nett revenue of railroads has generally exceeded the prediction of their friends. Take for instance, the Lowell railroad. Its friends issued a pamphlet, before it was subscribed for, and predicted in this pamphlet, that its nett annual revenue would be $36,000. This nett revenue has been, in

1836	$89,798
1837	102,261
1838	116,180
1839	149,068
1840	140,175

Twenty-five miles (the length of the Lowell railroad) give $140,-175 nett revenue per annum. If, then, the Western railroad gives in proportion to its length, (155 miles) its nett annual revenue will be $869,000.

Is the Lowell railroad (of which, before it was built, the nett was estimated at $36,000 a year) a greater channel of communication, naturally than the Western railroad, built in continuation of the Erie canal? of that Erie canal on which the freight, paid this year, will exceed $4,000,000?

Again—the tributary sources of a railroad increase in a ratio much greater than in proportion to its length—because the longer the road is, the wider the strip of the country whence it draws its tributary sources of revenue. A man will travel 30 miles on the common road, out of his way, for the sake of going 100 miles on the railroad—while he would only go 10 miles out of his way on a common road, for the sake of using 33 miles of railroad. Thus the strip of country tributary to the railroad, increases in length with the length of the road, and in addition to this, it increases in width.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 6, Vol. VIII. New Series.] MARCH 15, 1842. [Whole No. 402. Vol. XIV.

[For the American Railroad Journal and Mechanics' Magazine.]

New York, *February* 19, 1842.

Messrs. Editors: Through the medium of your useful Journal, allow me to acknowledge my satisfaction at learning that the process for preserving timber, etc., by the sulphates of iron and copper, as proposed by Dr. Earle, of Philadelphia, has at length, in a great degree, overcome the incredulity and neglect that have long withheld the public from a general use of it. I understand that the employment of it by the United States Ordnance Department for the last two years, has been attended by entire satisfaction, and confirmed confidence in its value; and that several of the most important canal and railroad companies of different States, have formed contracts with the Patentee within the last three or four months. To this number, I am especially gratified that our own Delaware and Hudson company have added themselves, within the last week or two. From the reputation and confidence it seems now to have established in public opinion, it may be presumed that most other companies will soon be found, in imitation of these examples, diverting to their interests the use of this cheap, effectual and money-saving invention.

In my own wrong, as a stockholder, I have been an unbeliever in the power and value of this process from the first promulgation of it until very lately,—considering it only as one of the thousand *humbugs* of the day; but I freely confess it was the skepticism of ignorance and prejudice,—such as still adheres perhaps, to many others. It was not until a printed paper, purporting to be a "Theory of the Process," and another containing several strong and incontestible facts, on the authority of disinterested persons, known to me, (both published by Dr. Earle) fell accidently into my hands, that I became sensible to the perverseness of the opinion I had indulged. Finding from these papers, however, that the principles which had been adopted by Dr. Earle were justified by Dr. Ure, of Glasgow, and that the materials employed by the former, were subsequently recommended by the latter, and placed by him (if I may so express myself,) in juxta-position with corrosive sublimate; and finding, also, according to the testimory of Mr. Archbald, the intelligent engineer of the Delaware and Hudson canal and railroad company, that a piece of rope, prepared with the sulphates of iron and copper, had resisted the decomposing influence of a fungus-pit equally with a similar piece prepared with corrosive sublimate, while a third piece, unprepared, had yielded to the destructive power of the pit and become completely rotten;—I was brought to the recollection of a *mathematical axiom* I had long since been taught at school,—that "*things which are equal to one and the same, are equal to one another;*" and thence began to more than suspect that for the object in view, the sulphates of iron and copper must be equal to corrosive sublimate; and that if the last possessed the preservative power, (which is universally admitted,) so must the proposed combination of the two former. It now appeared to me strange, and among the anomalies of science, that green copperas and blue vitriol,—those cheap and every-day materials,—should have been so long neglected, and, in a manner, stepped over, to reach the murcurial salt, for no better reason, that I could perceive, than that it was much more poisonous and much more costly.

Messrs. Editors: In this avowal of the conviction of my error, I have intended to make some amends to Dr. Earle for injury I may have done him, by the more than levity with which I have often spoken of his invention; and in repudiating my prejudice and declaring the strong interest I now feel in the credit of his discovery, to render what was due alike to him and to

Candor and Justice.

[For the American Railroad Journal and Mechanics' Magazine.]

FAILURE OF RAILROADS.

Your correspondent "X." in discussing Mr. Ellet's recent pamphlet on the "Failure of many Railroads," has the following remarks: "The ground taken by Mr. Ellet is, as I understand him, as follows: *That the present actual amount of trade and travel in all* *cases, ought to have been, and must in future be, the exact measure of the solidity and consequent outlay for both road and machinery.*"

Where "X." got this understanding of Mr. Ellet's views it is difficult to conceive, for there is certainly nothing of the kind in the pamphlet in question. I have just read it attentively, and do not find that it is proposed to make "the present actual amount of trade" the "exact" measure, or any other measure, either of the solidity, or cost, or strength of the road, or of its machinery, or of its furniture. There is no such idea advanced in any part of that pamphlet; but it is, on the contrary, expressly stated in the very outset, that the character of the road and the character of its machinery, should be selected with a view to the "economical accommodation of the trade which it is found may reasonably be anticipated," and to "the certain accomplishment of the duty to be performed."

This language is plain, clear and explicit; and your correspondent had no right to misunderstand it.

It is again observed,—to follow this critic,—"Mr. Ellet's other extreme, which contemplates a road to cost as high as $30,000 per mile, and a locomotive of twenty-five tons weight, about accords with the present progress made in this improvement." This clause is certainly true in part,—and it would still have been true, if it had been added, that the present progress of improvement in this respect accords with Mr. Ellet's recommendations *published five years ago*, in the appendix to an "Essay on the Laws of Trade," (pages 249—254,) where engines from fifteen to twenty-five tons weight are proposed for the accommodation of a heavy trade.

Your correspondent's opinion in regard to the good policy of the Winchester and Potomac railroad company, in running a locomotive, which they boast is able of itself (if it could only obtain the lading) to carry a vast deal more trade than the whole country can supply to their road; his view of the proper standard of velocity for the transportation of freight, twenty miles per hour and upwards, and his opinion in regard to the *necessity* of maintaining the same speed, "whether you have *one* passenger or a *thousand* to transport," are certainly all sustained by the practice of the country. It is against this practice that this pamphlet is directed.

Y.

[For the American Railroad Journal and Mechanics' Magazine.]

FAILURE OF RAILWAYS.

In your Journal of the 1st March, there is a communication signed "Z.," in defence of Mr. Ellet's pamphlet on the failure of railways, and complaining of a criticism in the Journal of the 1st February, on a separate communication from Mr. Ellet, in reference to that pamphlet, the principal positions of which, he therein recapitulated, and to which that criticism was specially confined, the pamphlet itself having been mislaid, and in that recapitulation there is nothing of the qualification referred to by "Z." as necessary to give Mr. Ellet's true meaning.

It is admitted, however, by "Z." that Mr. Ellet's system of railways must be in *exact proportions* to the amount of trade and travel, this being determined by that "*which may be reasonably anticipated.*" This qualification does not, however, mend the matter, but as the very basis or main one of the component parts of his system, it is to it the others must conform, and therefore the necessity of making a fixed quantity of that which is of so intangible and variable a nature, and of all things the most susceptible to langor or activity, according to the degree of stimulus applied to it; and so very active in this way have railways been found, that generally the most reasonable anticipations have been altogether outstripped,—as for instance, among many others, the Boston and Lowell road, which started on the basis of a nett income of $36,000 per annum, but which in a very short time rose to nearly $150,000 per annum. How very soon then would they have found themselves *straightened*, had they adopted a road suited only to $36,000 per annum, on Mr. Ellet's plan of "making the provision in all cases commensurate with the duties to be performed,—the trade and travel to be accommodated."

Could it indeed be properly called an improvement without this stimulus? And of what is this composed, but the three expensive ingredients of *power, speed and security*,—the most exact admixture of these, constituting the perfection of the railway. If this be the true principle, let us see in how little Mr. Ellet has conformed to it, taking his first case, *fixed* by him as a starting point, and described as follows at page 11 of the pamphlet: "If the company can *anticipate* but eighteen to twenty passengers," then are the rest of the proportions to be:

A wooden road, to cost $1,000 per mile.
An engine of half a ton, to cost $600,—[wooden too?]
An engine and car *shed*, to cost $50.
Light one-horse passenger cars, to cost $200.
No embankments or grading.

All to be managed by ONE faithful hand.

And from this he ascends up to a graded iron road until he reaches a cost of $30,000 per mile of road, and an engine of twenty-five tons, the power and capacity of road and machinery being thus made to slide and adapt itself exactly to the "certain accomplishment of the duty to be performed, and the economical accommodation of the trade which it is found may be reasonably anticipated." Here we might be frightened at the expense of frequent change which a rapid progress of the community might entail, particularly after reaching the *iron stage* of the system, did we not feel pacified by the fullest confidence in the *stationary effect* of Mr. Ellet's first contrivance, as above described, out of which we do not see how it could ever hope to rise.

But in all this, "Z." says there is nothing *new*, being only in conformity to the time honored aphorism, that *the means should be proportioned to the end*, which is very true, and is equally applicable, whether our end or that of Mr. Ellet is designed by a railway.

As to the speed of five to six miles per hour, adopted by Mr. Ellet, as the best and most economical for most kinds of burden trains, being confirmed by Edward Woods's experiments on railway constants, we do not concur. According to our understanding of these experiments, they only go to show that at six miles per hour there was less friction, and consequently less resistance to the speed of a train, and could not be intended to say that at ten to twelve miles per hour, with the same expense of capital, wages, fuel, oil, etc., as at half that rate, the gain in economy of time, would not greatly overbalance the mere fraction of loss from the additional friction of the higher speed. If gain in time is to be of no consequence, better adhere to the six-horse team, which travels at four to five miles per hour, or little short of Mr. Ellet's rate. At ten to twelve miles per hour, for merchandize, and double that rate for passengers, are now determined by the experience of this country and England as the rates most compatible with true economy on a railway. Other circumstances than the relative friction of different rates of speed, go to determine this question.

According to "Z.," this system of Mr. Ellet's is only an old one of Mr. Thomas Earle's, which the public have disregarded to their ruin, and is now revived by Mr. Ellet in a more imposing form, having received the sanction of all past experience. If this were so, why is the old system still persevered in *all over the world*, and receiving new impulses every day, instead of being abandoned. It cannot be that these gentlemen are alone right against the world. At least, for one, we do not believe in their system, except as treating of the *fetters* rather than of the *facilities* of intercourse, and as therefore opposed to the true spirit of the age.

The railway is not now undertaken without due consideration; and if we have not greatly misinterpreted the signs of the times, is esteemed only worthy of attention as the three ingredients of *power, speed and security* can be most efficiently united in it. We would, therefore, have it proclaimed on the house-tops, as at least our view of the truest economy of the railway, that when it is determined to construct it for locomotives, whatever may be the reasonable anticipations of its projectors, these properties cannot be too predominant, as most congenial with the natural elasticity of the community, and as necessary to meet and *keep ahead* of its own quickening influences.

We conclude, by adding the views of our English friends on the effects of the railway as now constructed in England, and as imitated by us in this country with entire success:

"Not only do these railways facilitate trade and commerce and give increased activity to mercantile interests in general, but if we consider that the expenditure of a railway consists principally in the wear and tear of machinery, the produce of human labor, the greater part of which is dug from the bowels of the earth and formed by human skill, we shall see that many new and important departments of commerce and trade *are created and fed* by this new economic and social power. This new element is extending the range of action *so fast and so far*, that there will soon cease to be any sections of the community, or any individual in society, sufficiently severed from its immediate interests, to be altogether beyond the sphere of its influence. All classes will soon be embraced in the multitudinous constituency of railway directors, or holders of railway stock. The economical transport thus provided, has rendered the most laborious and poorest portion of the community, not only the class on which the greatest benefit has been conferred, but that also which has contributed most abundantly to the success of these undertakings, as thousands now travel by this *most rapid* conveyance who were not before able to avail themselves of any. *The subject is therefore one, which must sooner or later come closely home to the interests of every member of society.*"

X.

[For the American Railroad Journal and Mechanic's Magazine.]

MINE HILL AND SCHUYLKILL HAVEN RAILROAD.

The report of this company for the year 1841, shows a very satisfactory result for its proprietors, and is an example that when a railway has plenty to do, *even with horse power*, it never fails of success. This concern has been managed very judiciously.

In 1831, about the period of it commencement, the tonnage was only 17,500, but which had increased to 238,000 tons in the past year of 1841.

The tolls received in 1841 amounted to, - -		$53,990
The expenses were, for repairs and maintenance of road, - - - - -	$5,929	
For salaries and expenses of the road, -	1,670	
Interest on loan, - - - -	2,486	
		10,085
		$43,905

Out of this, a dividend of 15 per cent. was paid to the stockholders, besides a tax on the dividend of 5 per cent. to the State.

The length of the road, including branches, is 20 miles, and the capital invested therein is, so far, - -	$277,600
A loan on mortgage, - - - - -	40,000
	$317,600

It has in part of late been relaid with a substantial heavy rail of 62 lbs. to the yard, and the charge of transportation over it to the navigation at Schuylkill Haven, for use of road, car and horse power, is 50 cents per ton.

This district has thus quickly sprung into prominence, owing to a lower rate of mine rent, fewer props being required in the mines, and a smaller charge for freight and toll,—the whole making a difference of 50 cents in favor of this district as compared with Pottsville. This is equal to a remission of the toll over the lateral railway, or tantamount to bringing the canal up to the mines.

Heretofore the quality of this road has been best suited to horse power, but with its present permanent character, and with the large tonnage to be transported over it, steam power hereafter will be undoubtedly the cheapest, as will be seen by the comparative cost of the two:

Horse power,—

Ten cars, each 3 tons, cost $80 each,	$800		
Two horses and gearing, 100 "	200		
		$1,000 at 6 pr. ct. in.	$60
Wear and tear of horses and cars at an average of 10 per cent.,			100
Amount carried over, - - - - -			$160

Amount brought over, - - - - - -	$160
Oil, etc., - - - - - - - -	50
Wages of driver for 200 working days, at $1 per day, -	200
Keep of two horses for the year, at $150 per annum, -	300
	$710

200 working days, at 27 tons nett per day, is 5,400 tons or equal to a cost of, - - - per ton, 13 cts.

Steam power,—

One locomotive could make 5 trips per day over 10 miles of road, and deliver per day, say, 1,000 tons, or for 200 days, 200,000 tons, at $25 per day, is $5,000, or equal to a cost of, - - - - - per ton, $2\frac{1}{2}$ cts.

The average charge for horse power and use of cars is now about $22\frac{1}{2}$ cents, which leaves, at a cost of 13 cents per ton, as above, a profit of 40 per cent. between the car owner and the driver.

It is evident from the above, that there is an immense disparity in favor of the use of steam power, even over these 10 miles; but the full economy of the operation would not be obtained, until the train from the mine, or as near to it as possible be run *clean into the hold of the vessel* on the Delaware, which could be done in about the same time that is now taken on the branch road to effect a delivery into a canal boat, 100 miles off from the vessel or a market, the delay, expense and uncertainty of which, would be thus avoided, and the operation be kept up four months longer than in the other case.

But we well know the difficulty of overthrowing existing interests, and of changing from old into new habits of business,—and that now the pressure of the times only aggravates that difficulty. Were means abundant, the railway could readily put matters into a new train, but as things are at present, it must be a slower operation. Having grown up with the navigation, and as mere feeders to it, these lateral railways have all their sympathies in that direction, and are somewhat scared at being stretched from 5 and 10 miles to 100 miles of length, at which their economy can only be best developed.

The omnipotence of steam power must ere long be recognized, and as the still more powerful influence of interest begins to work throughout the region more in unison than is now the case, the main stem of railway will come into better favor,—and particularly with the important branch now under discussion,—which by means if it could so readily swell its annual trade to 4 and 500,000 tons, and increase its dividends to 20 per cent. And in view of the competition and diversions with which this district is threatened on all sides, its policy would seem, and no doubt will be, to afford every possible facility to its operators. None will be found to equal a cordial co-operation with its *natural ally*, the main stem of railway to the Delaware; but to show that the managers of this branch, whose report is dated on the 10th of January, the day on which the completion of the main stem was celebrated,—still hold its advantages as somewhat problematical,—we extract their cold and constrained allusion to that event in their said report:

"In closing this brief exposition of the company's affairs, the managers are induced to remark that the extension of the Philadelphia and Reading railroad to Pottsville, *may be* regarded as another outlet through which individual enterprize *may be* exerted, and when viewed in connection with the works of the Schuylkill navigation company, which have hitherto so largely contributed to the advantages of the coal region, it will be perceived that these important public works, effected at great expense, will hereafter furnish every possible facility demanded by an increasing coal trade.

"On behalf of the board of managers,

"JAMES DUNDAS, *President.*"

We give below, from the report of the Schuylkill navigation, an abridged view of the business on the canal in the last season of 1841, as well as how it stood as to cost on the 1st January, 1842, an important epoch for it, as the beginning of a competition from the Philadelphia and Pottsville railway for the valuable trade it had hitherto monopolized. The price of its stock is now worth about $40 for $50 paid:

Schuylkill navigation,—

Capital stock, 33,312 shares, at $50 per share,		$1,665,000	
Loans, - - -	$1,993,400		
Deduct, to be paid off in 1842,	248,400		
		1,745,000	
Bonds for damages, - - -		8,000	
			$3,418,000

Business in 1841,—

Tolls on 584,700 tons coal,	$482,500	
" other articles,	75,200	
		557,700
Rents, etc.,		18,300
		$576,000

Deduct, paid,—

Maintenance of canal, current repairs, salaries, lock tenders, etc.,	$113,300	
Damages of freshet of 8th January, 1841,	80,900	
Interest on loans in 1841,	112,300	
		306,500
Balance remaining in 1841, applicable to dividends or paying off loans, etc., of the coal shipped on the Schuylkill canal,		$269,500

	Tons.
Left on the line of the canal,	40,600
Shipped at Philadelphia in 3,065 vessels,	367,800
Consumption of Philadelphia,	96,000
	504,400
Shipped direct from Pottsville, through the Delaware and Raritan canal, in 1,354 canal boats,	78,300
	582,700

This report concludes with the following remarks:

"The board of managers at all times desirous of promoting the general interests of the trade, and believing that the time has now arrived when a further reduction of the toll on coal would be beneficially felt, on the ground that the lower the price at which it could be sold, the greater would be the consumption, and consequently an increased quantity would be brought to market, have concluded to fix the rates for the next season upon all the different descriptions, as follows:

From Mount Carbon to Philadelphia,	75 cents per ton.
From Schuylkill Haven to Philadelphia,	75 "
From Port Clinton to Philadelphia,	56 "

"It may not be amiss to remark, before closing this report, that although the sum of money expended in effecting a repair of the damages caused by the flood of January, 1841, has been large, yet it is with great satisfaction the board of managers can, with confidence, assure the stockholders that there has not been only a repair of those damages, but that the works have been most materially strengthened at every point which had yielded to the force of that extraordinary flood; nor can there be any doubt but that the navigation throughout the whole line has been greatly improved by the extra expenditures of the last year.

"JOSHUA LIPPINCOTT, *President.*"

[For the American Railroad Journal and Mechanic's Magazine.]

In presenting you the fifth annual table, compiled from the reports of the several railroad companies of Massachusetts to the legislature, of their receipts, expenses and dividends, it is with regret I have to remark on the insufficiency of the details, to arrive at conclusions so desirable to the friends of the railway system. These working details are useful to sustain the arguments in their favor and to correct the canal mania engendered by the success of New York, with her Erie canal.

It is a source of congratulation to the friends of railways that the improvements in the locomotive, added to the adoption of the edge rail, to transport great burthens at cheap rates, has turned the tables against the canal advocates. The high sounding names that were enlisted, by the Duke of Bridgewater and by the advocates for canals in this State in 1835, are now content to withdraw their often repeated erroneous statement, that railways were in the proportion, of 1 to $4\frac{1}{3}$ as compared with canals. In view of the light shed on this subject recently, we trust the present legislature will not rise without taking from the record that foul blot on the intelligence of the State, when the canal board put forth the dogma in 1835, (Assembly Doc. 296) that the actual cost of transporting a ton of goods on a *level* railroad was $3\frac{1}{2}$ cents per ton per mile, and the Mohawk and Schenectady railroad, with two inclined planes,—horse power at both ends, was instanced to prove the truth of this position palmed off on public credulity by the canal interest, then the "lords of the ascendant" in this State.

The features presented by the reports of the past year, do not show any improvement in the expenditures of the several roads, compared with the receipts. There is something defective in their management, or it is more than probable, there is a difficulty with these short railroads to produce the same relative results, as those produced on extended lines. It is ascertained, that a locomotive engine to run 80 to 100 miles per day, can do her work and be kept in order with less expense, than an engine on a short line of railway, the engine driver, fire and brake men being the same daily expense on each road.

There is one improvement in the reports of this year,—they have given us the number of miles run, over their roads, but without reference, to the number of miles run by each engine or the number of engines to do the work. The repairs of the engines have not been kept separated from those relating to the passenger cars, nor have these been kept distinct from the freight cars, to ascertain the cost of transporting a passenger as well as a ton of goods each mile. A new column has been introduced, giving the number of miles run on each road, as well as the cost per mile, exclusive of the interest on the cost of the road.

The table presents the fact in the dividends, that the railroad system is completely successful in Massachusetts. Railroad stock is now sought after by the farmer, as a better investment than bank stock in Massachusetts. They are considered a safe investment, increasing in value with their population.

It should be noticed, that the increased expenses on the Boston and Lowell railroad arises from taking up 7½ miles of light iron 36 pounds to the yard, and substituting the edge rail of 56 pounds to the yard. The Boston and Worcester in their expenses have had to submit to a change and improvement of their road and depots, to meet the heavy freighting business, this railroad must now be prepared for, since the completion of the Western and Albany and West Stockbridge railroads, to the outlet of the Erie canal.

The gross amount of receipts, the last year on the several railroads completed with the exception of the Western, was, - - - -	$1,525,938
The expenses to operate the same, including, new rails as above, depots and permanent fixtures, belonging to capital, - - - - -	811,581
	$714,357

This is equal to 7 per cent. earned, on their cost of $10,000,000, if we exclude the cost of the Western railroad, which only went into operation this winter.

Total receipts on the several roads enumerated in the table, from 2 to 5 years, - - -	$5,343,226
Total expenses on the several roads, - -	2,751,533
Receipts from freight and the mails, - -	1,816,424
" " passengers - - -	3,525,804

TABLE of the cost, receipts, expenses, income and dividends of the Railroads in use in Massachusetts: Compiled from the annual reports to the Legislature, of 1842, *made by the several Corporations, under oath. Also, a comparative view of the Boston and Lowell, the Providence and the Worcester railways, for the years* 1837, 1838, 1839, 1840 *and* 1841, *inclusive, with the Lowell and Nashua and Taunton railroads, for* 3 *years. Prepared by* JOSEPH E. BLOOMFIELD.

NAME OF ROAD.	Date.	Length.	Expended in cost of road.	Cost of road per mile.	Rep'rs of engines and cars.	Rep'rs of road.	Rep'rs en'gs & cars per mile.	Rep'rs of road per mile.	Fuel, oil, salaries and incidental expens's	Total expenses.	Total receipts.	Income from passengers.	Income from freight and the mail.	Dividends per ann.	Miles run.	Cost per mile run ex. of interest on capital.	Maximum grade.
Boston and Lowell,	1837				16,633	14,056	650	546	33,424	78,508	180,770	117,643	63,137	7			
Do.	1838				10,945	15,734	421	611	48,917	75,597	191,780	109,083	82,697	7			
Do.	1839				16,384	18,843	636	731	66,923	92,151	241,220	135,037	106,131	8			
Do.	1840				14,455	21,013	561	816	55,932	91,400	231,575	127,008	104,567	8			
Do.	1841	25¾	1,834,893	71,290	22,644	33,193	870	1,200	63,631	119,469	267,541	145,953	121,588	8	126,300	81½ cts.	10
Boston and Providence,	1837				29,794	11,707	726	285	114,737	156,238	250,882	193,469	57,413	8			
Do.	1838				19.953	16,866	486	411	83,234	120,044	265,114	196,974	68,140	8			
Do.	1839				19,467	8,604	474	209	65,491	193,562	313,907	234,237	79,670	8			
Do.	1840				16.764	13,281	409	334	78,413	143,127	202,601	134.651	67,949	7			
Do.	1841	41	1,782,000	43,460	12,723	24,474	309	597	84,857	122,057	230,821	152,015	78,806	7	107,638	93 "	37½
Boston and Worcester,	1837				20,053	9,185	450	206	65,524	94,762	210,047	123,331	86,716	7½			
Do.	1838				15.672	12.521	359	281	42,534	85,572	212,324	112.032	100,292	7½			
Do.	1839				25,198	18,035	664	405	83,151	126.384	231,807	122,496	109,311	6			
Do.	1840				16.667	40,731	374	830	83,043	140,441	267,547	170,856	96,692	6			
Do.	1841	44½	2,374,547	53,360	27,584	34,900	620	784	100,514	162,998	310,807	190,097	110,001	7	175,000	93 "	42
Lowell and Nashua,	1839				2,273	3,949	156	272	23,663	29,865	56,063	36,647	18,406	6½			
Do.	1840				4,737	3,447	332	243	24,763	52,532	82,638	35,794	46,849	7½			
Do.	1841	14	380,000	27,143	8,263	3,149	589	225	84,653	95,966	132 496	75,732	56,764	8	43,500	85½ "	10
Eastern, incomplete,	1839				8,563	6.527	214	163	38,084	53,174	125,622	113,068	12,564	5			
Do.	1840				12,916	7,909	516	316	64,968	85,793	183,296	164.971	18,326	5			
Do.	1841	60	2,267,000	43,000	17,820	31,117	309	520	94,381	154,958	299,574	257,734	41,840	6	191,900	81 "	—
Taunton branch,	1839				3,159	1,397	287	127	36,161	40,711	58,018	40,910	17,108	7			
Do.	1840				1,714	2,609	156	237	40,348	44,671	75,477	44,900	30,577	6			
Do.	1841	11	250,000	22,727	2,263	1,878	205	170	50,912	55,043	76,928	52,279	24,646	7½	20,816	98 "	—
New Bedford and Taunton,	1840				1,318	2,565	120	233	9,162	13,020	26,437	23,250	3.186	6			
Do.	1841	21	[400,000	35,555	3,654	3,410	325	302	15,210	22,285	52,513	39,469	13,044	6	27,039	82 "	—
Norwich and Worcester,	1840				—	—	—	—	—	52,503	116,517	78,900	37,617	6			
Do.	1841	58½	1,777,471	30,380	7,721	6,339	119	108	64,762	78,805	155.261	102.667	52,594	6	—	—	22
Western,	1840				6,289	10,289	132	161	45,501	62,071	112.347	70,821	41,526	-			
Do. not completed,	1841	117	5,235,026	44,470	16,979	20,207	145	577	67,619	104 806	182.306	113,841	68,467	-	160,100	65½ "	80
Total,	—	392½	16,300.937	41,452	—	—	—	—	—	2,751,633	5,343,226	3,525,804	1,816,422	—	851,293	—	—

An inspection of the table, presents the interesting fact that the freighting business is gradually on the increase, and in the proportion to passengers as 1 to 2 of the receipts. The Boston and Lowell railroad gives the largest dividends, with great regularity, and nearly half of them is derived from freight, and this too, from the bulky article of cotton, which leaves the Middlesex canal on its border to seek the celerity of the railroad. The Boston and Portland railroad, 25 miles in length, has been omitted in setting up the table. There has been expended on this road $553,290. The amount received from passengers was $85,928. From freight $30,-088. Total $116,016. The expenses were $82,021.

It will be perceived, that in some instances, the total receipts do not correspond with the expenses and repairs on road, engines and carrages, fuel, oil, etc., arising from items that are not classed.

The Norwich and Worcester railroad company have given their returns more in detail than any of the other roads, but from their not reporting the number of miles run,—engines and cars used, desirable results cannot be arrived at.

The grades, curves and straight lines on the several railroads, are of course a test of their capacity for cheap transportation and celerity of motion. It is desirable to know these. A column has been inserted for grades, supposed to be correct, although not official or from the reports to the legislature. It is hoped that the next report of the Western railroad company will state with precision the grades, curves and straight lines over the Western railroad. Some have placed the grades at 80 feet to the mile, others at 85 feet.

The expenses proportioned to the receipts on the several roads in Massachusetts, vary at different periods from 40 to 60 per cent. Fifty per cent. may be considered the average for a period of several years. This is too high compared with the best managed English railways. As respects the English railroads, we find that the chairman of the Leeds railway, 51 miles in length, on the occasion of its recent opening, remarked: "The next important subject was the expenses of working the line, taking every pains to ascertain the probable amount by a careful examination of the results on the Leeds and Birmingham, Grand Junction, etc., to include maintenance of way, depreciation of stock, and in fact *every charge* that could come in, he found, that with a receipt of £300,000 per annum, the expenditures could not exceed £100,000 per annum, or equal to 33 per cent. on the gross receipts, which would leave 10 to 12 per cent. nett dividend on the cost of the road"

This presents a very different result to the several roads enumerated in the table. It tends to confirm the position that long lines are managed with more economy than short lines, and the sooner the stockholders merge them into companies with long lines when it is practicable, the less will be the expenses for superintendance, management, etc.

The Utica and Schenectady railroad has the disadvantage of light flat bar, which, during the last year, in part, caused the extravagant outlay of $65,270 for "*repairs of roadway and fixtures*," (equal to $860 per mile,) yet we find this road of 78 miles, earned during 1841, $398,460, at an expense of $126,347, being in the ratio of less than 32 per cent.

It should be taken into consideration that this road is used entirely for passengers, while the eastern railroads have to be prepared for a freighting business at great expense, of which there is but a very limited amount in proportion to the capacity of their roads to transport it. If this company had the priviledge of carrying freight, free of tolls, they could reduce their fare 50 per cent. on passengers, and still give an interest to their stockholders of from 10 to 12 per cent. per annum. It is high time that this restriction was taken off.

To include the cost of the Boston and Portland railroad, 25 miles, $553,290, and the Albany and West Stockbridge railroad, 38 miles, built by the Western railroad company, in continuation of their magnificent work, it will be perceived that the citizens of Massachusetts,—not the State,—own 455 miles of railways. These roads have cost $18,266,227. One, the Boston and Lowell, has a double track complete,—others only in part. The whole were built at a period when labor, materials, and particularly iron, was full 33 per cent. higher than at the present period. The right of way was an extravagant item with many.

The success of Massachusetts with her roads has done much to dispel the errors afloat relative to railways as a productive and safe investment. To make them more popular, I would suggest that the dividends be made quarterly. The monthly publication of receipts and expenses would give increased confidence in them as an investment for widows and minors, as there is little room for peculation.

I would again take the liberty to suggest that the several railroad companies in Massachusetts and other parts of the United States, make an annual return to your office of the repairs and expense of running their locomotive engines, with the number on each road,—the repairs of the engines should be kept separate from that of the passenger cars, and the freight cars,—these again should be divided. The items of fuel, oil and wages for *engine drivers* and brake men, salaries of agents, office and incidental expenses, should be so arranged as to arrive at the cost of *motive power* per mile to operate the road for freight as well as for passengers; the miles run, the through and way passengers, the receipts for each as well as for freight is desirable. Should the several companies give their attention to these details, a comparison of the present with the preceding years will no doubt tend to very useful results, each will contribute his mite of useful information to the general stock, to be distributed by your very useful Journal.

I cannot close these hasty and ill digested remarks, without stating my full conviction that the introduction of the railroad system in the United States is destined to change the mode and time of doing business. The "*business season*" for the seaboard cities will be the whole year. The safety and certainty with which balances can be remitted, when required in the precious metals or in goods and produce, is destined to make railways the best regulator of exchange. For defence and the transmission of the mail they are invaluable,—they merit, and should receive the fostering care, both of the General and State governments. The one hundred millions of dollars now invested in above 3,500 miles of railways completed in the United States, should command from the General Government a bonus to them of at least $25,000,000 for their use, instead of the parsimonious aid yielded to them by the Post Office Department.

JOSEPH E. BLOOMFIELD.

STEAM NAVIGATION.

As another stage in the progress of steam navigation we record upon our pages the appearance in our harbor of a steamer of the largest class, employed as a West India mail vessel. The *Clyde*, of over 1,800 tons, is the first of a line intended to touch regularly at our port on her way from the West Indies and Halifax and back again. An arrangement has been made by which these vessels will carry passengers and letters to and from our principal seaports.

Much anxiety has been felt in regard to the Caledonia, whose non-arrival at Halifax has caused the most serious apprehensions as to her safety. It appears that a gale occurred which in violence has scarcely ever been exceeded, and in which it is feared she must have been overwhelmed. The time has not yet arrived, in which we can receive any information of her having put into some harbor out of the usual track, and we hope that we shall ere long hear of her preservation even if much injured.

The following description of the steam excavator, is the first extended notice we have been able to procure. Two of these machines are now employed at Fort Green, Brooklyn, in excavating the hill and filling a deep hollow on the border of the former salt marsh. We have several times paid a visit to this truly wonderful machine, and gazed with astonishment upon its untiring labors. Many steam excavators have been invented, but as far as we can ascertain, this is the first that has been brought into successful operation. No one can form an adequate idea of its powers, without seeing its operation.

Several paragraphs have appeared in the daily papers, stating that this machine cannot, under the most favorable circumstances, perform the labor more economically than men with horses and carts. This can hardly be the case, for the quantity removed at each dip of the shovel is enough to fill three ordinary carts, and the time consumed, bears no proportion to that required by the old process. No advantage could be gained by the increase of men, because the face of the hill exposed, could not easily admit a great number to labor at once.

If the advantage is on the side of the machine in clear sand, it is much more so when bolders of any size occur. These the machine lifts and removes with the greatest ease, and in a manner that defies all competition by human hands.

Upon the whole, we are satisfied, that the inspection of the machine in operation, will go far to convince any unprejudiced person, of the superiority of this machine.

STEAM EXCAVATING MACHINE.

The steam excavator, which has been at work for several months past upon the line of the Schenectady and Troy railroad, continues to excite a lively interest among our citizens, thousand of whom have been prompted by curiosity to pay it a visit. The triumphant success attending its execution in a material hitherto untried, and in which the skeptical had predicted, it would be impossible to use it, has surpassed the most sanguine anticipations of its friends, and inspired the public with fresh confidence in its merits. It is most emphatically a labor saving engine—a novel and ingenious arrangement of the mechanical powers—another application of the one great revolutionizing agent, steam, to the useful purposes of life. It is an original idea and a universal good. It is one of those rare inventions, where genius seems to have marked out for itself an independent field of action, and the benefits flowing from which are destined to be known and felt throughout the civilized world.

The utility of the machine is no longer a matter of speculation. In clay, sand and gravel, the materials most usually encountered in excavations of great magnitude, it has enjoyed the "full tide of successful experiment," and its advantages, not only in the saving of labor, expense and trouble, but in the expediting of work are established beyond the possibility of doubt.

The steam excavator was brought into use about four years since on the Western railroad in Massachusetts. It was invented by William S. Otis, since deceased, a man of extraordinary mechanical genius, and a member of the well known firm of Carmichael, Fairbanks and Co., railroad contractors. A patent right, embracing the most recent improvements, has been secured and the proprietors are now making arrangements for its use upon a scale in some degree commensurate with the magnitude and merits of the invention.

The machines hitherto constructed, varying in power from eight to sixteen horses, have cost from five to seven thousand dollars. The one in use upon the Schenectady and Troy road is of the medium size, and is at work in fine compact marley clay of both the blue and light colored varieties. It is estimated to do the work of fifty or sixty men. Only two men are employed in its operation—the engineer and conductor, or man at the shovel, wood and water being provided by other attendants.

It is easy to conceive how varied must be the duties of a machine calculated to perform at once the offices of the pick-axe, the shovel and the man. A great variety of motions are required in breaking up the material, filling the shovel and depositing its burden in the vehicles which are to remove it from the excavation. All these the machine accomplishes with a most perfect regularity and precision. The trunk of the tamed elephant, as he quietly addresses himself to his master's bidding, is no inapt emblem of the grace, majesty and strength of its movements.

At first glance the machinery of the excavator, from the novelty of its appearance, strikes one with the idea that it is extremely complicated in its structure, and hence, liable to be often deranged and thrown out of repair, and, withall, expensive of maintenance. But this illusion is soon dispelled. A more careful examination convinces us that simplicity is a chief attribute, and the first impression is followed by a sentiment of profound admiration at the display of mechanical ingenuity which has been exhibited in making so simple a combination of wheels, levers and chains, to perform so many and such varied operations.

It would obviously be impossible to trace the arrangements of the machinery through all their detail, without reference to drawings and models. We shall attempt however to give some general idea of its construction, and at the same time follow out the principles upon which its action depends. In the first place, then, the steam engine, boiler and connecting machinery, are situated in a strong carriage, resting upon a temporary railway track laid for that purpose. The shovel, which has a capacity of one and a quarter cubic yards, is suspended by a chain tackle of the ordinary construction, at the extremity of a sort of crane or boom projecting from the top of a mast about twelve feet high, which stands on the front part of the carriage, and over which the power acting through the tackle is communicated. The shovel consists of a square iron box with a handle of strong wood attached to the side in such a way as to give it the form and appearance of a ladle. It is armed in front with heavy wedge shaped teeth about eight inches long, which serve to break the material in advance of the shovel, and also to remove any obstacle which might come in contact with its edge. To follow the machine through a single round of its functions; the shovel is first brought to the bottom of the pit, in a position nearly horizontal, with the handle projecting upward and passing through the brace work of the crane, by which means a steady action is at all times secured. The chain tackle, acting from the end of the boom, and attached to the shovel by a ball and pivots, and deriving its power from a grooved windless on the carriage around which the chain winds, then commences to draw the shovel forwards and upwards, while another chain made fast at the end of the handle and winding in the same manner on a drum situated in the brace work of the crane near where the handle passes, serves to press the shovel against the face of excavation in its upward passage, and thereby to regulate the depth to which it penetrates. This latter chain is so adjusted, by means of a friction wheel and levers, as to exert just so much power at any instant as the operator may choose to apply. The friction wheel also protects the shovel and other machinery from any unforseen danger; for as all the power which acts to apply the shovel is transmitted through this wheel, and the friction is regulated to correspond with the strain which may safely be encountered, it is evident that whenever the shovel is suddenly arrested by a large rock or other impediment, the shock will not be felt back of the point where this wheel is situated and other parts of the machinery, including the upward motion of the shovel, may continue to move on as though nothing had happened.

The shovel is generally filled by the time it has risen ten feet, when the chain tackle ceases to act, and the shovel remains suspended by it from the end of the boom, with its centre of gravity slightly in advance of the point of suspension. The chain connected with its handle now relaxes and the shovel retreats, by its own gravity, two or three feet from the face of excavation, and the crane swings round till the shovel comes directly over the cars standing at the side of the machine. The load is discharged through a movable bottom, turning upon hinges and secured by a catch, the connecting rod of which terminates upon the stand of the conductor. The crane now swings back to any position within a half circle where it may be desirable to take up the next load, while, at the same time, the shovel falls to the ground, the movable bottom clasps itself, and all is ready to proceed as before. The alternate swinging motion of the crane is produced by a chain coming from a driving pulley situated near the engine. The middle portion of this chain being occupied by the driving pulley, the two parts lead upward to the roof of the carriage, from which their direction being changed over small pulleys, they pass around to opposite extremities on the rim of a horizontal semi-circular frame, made fast to the boom and projecting from what may be termed the rear side of the mast.

When all the material within reach of the shovel has been removed, rails are laid down and the machine advances by its own locomotive power to a new station. This motion is accomplished by simply gearing the main shaft of the engine to a cog wheel on one of the axles. The distance moved is usually about three feet, and the time occupied in changing places does not exceed three minutes.

The average time consumed by each revolution of the shovel is forty-five seconds and the quantity taken up in broken clay varies from one-half to three-fourths of a yard, solid measure. Taking the result of one hour at forty yards, which is making a liberal allowance for contingencies of all kinds, and reckoning eleven hours per day, and twenty-four working days per month, we have eleven thousand five hundred yards for the average monthly performance of the machine in clay excavation. In sand and fine gravel, upon other public works, it has repeatedly accomplished eighteen thousand yards in the same time.

The excavator used upon the Schenectady and Troy railroad is now at work near the "deep cut" on section No. 3, one and a half miles west of the city. It will be employed here till June or July next, at which time the whole road will have been completed—this being the heaviest section on the line. Meanwhile we trust that all, who have a taste for novelty, or feel interested in the progress of mechanical improvement, will embrace an opportunity of witnessing its performances and satisfy themselves of the benefits, which are to result from its use in the construction of railroads and other improvements.

But its advantages are not to be enjoyed by public work alone. There is no doubt but it may be applied successfully to the ditching of large tracks of level country such as are every where to be met with the southern States. Wherever channels are required of sufficient size to allow of its being applied in the usual manner, (say six feet deep by ten feet in width,) its operation would be attended with most decided economy; and, in drains of less dimensions, it might be used with nearly equal success by slightly varying the motion of the shovel so as to allow the carriage to stand upon the surface of the ground.—*Troy Daily Whig.*

WATER COMMISSIONER'S REPORT.

WATER COMMISSIONER'S OFFICE,
January 14, 1842.

To the Honorable the Common Council of the city of New York:

In obedience to the act of the legislature of the State, the undersigned present this, the third semi-annual report, which has emanated from the Board of Water Commissioners since the undersigned have had charge of the Croton aqueduct.

The undersigned have continued, from time to time, since their last report, to deposit with the comptroller of the city, the vouchers for the payment of money, the deeds for lands taken, and all releases and compromises of damage, for obstruction of highways, and extinguishment of water rights on the Croton river, rendered necessary by the proposed diversion of the water to the city.

They have also made up a general account current, for the comptroller, commencing from the first day of January (the date of the last general account) and continuing until the 31st of December last; which account we pray may be examined by the finance committee, in conformity to the laws of the State.

Expenditures made by the Water Commissioners, under the act to supply the city of New York with pure and wholesome water, from the commencement, to January, 1842.

From July, 1835, to Jan. 1836 - - -		$31,828 02
" Jan. 1836, to July, "	$12,070 84	
" July, " to Jan. 1837	28,099 58	
		40,170 42
" Jan. 1837, to July, "	62,602 85	
" July, " to Jan. 1838	233,856 93	
		296,459 78
" Jan. 1838, to July, "	605,766 76	
" July, " to Jan. 1839	984,445 70	
		1,590,212 46
" Jan. 1839, to July, "	715,362 01	
" July, " to Jan. 1840	1,243,827 13	
		1,959,189 14
" Jan. 1840, to July, "	1,043,108 31	
" July, " to Jan. 1841,	1,030,651 46	
		2,073,759 77
" Jan. 1841, to July, "	421,540 13	
" July, " to Jan. 1842,	697,303 31	
		1,118,843 44
		7,110,463 03
Less the amount hereinafter referred to, - -		3,000 00
		7,107,463 03
To this sum add a warrant in the hands of the Commissioners, payable to Abigail Faure,		176 00
		$7,107,639 03
Amount appearing to the credit of the Mayor, Aldermen and Commonalty, etc., on the books of accounts in the Water Commissioners' office, on the 31st of December, 1841, deducting the sum of $3,000, and the discrepancy of $2 51, mentioned in previous report, - - - - -		7,107,235 19
Leaving a balance of, - - - - - - due the Water Commissioners.		$403, 84

Expenditure for 1841, is $1,118,843 44, which may be arranged as follows:

First.—Constructing the aqueduct, bridges, re-building and extension of the Croton dam, etc.		$770,167 32
Second.—Iron pipes, - - - - -		239,400 00
Third.—Extinguishment of water rights on Croton river, - - - - - -		7,728 25
Fourth.—Repairs on the line of aqueduct, - -		11,499 55
Fifth.—Real estate in fee, - - - - -		1,400 00
Sixth.—Earth for embankments, and damages occasioned by the construction of the aqueduct, etc., - - - - -		2,230 42
Seventh.—salaries of the commisioners and clerk, - - - - - -		6,750 00
Eighth.—Legal expenses, - - - -		1,671 81
Ninth.—Salaries of engineers and inspectors, incidental expenses, etc. etc.,	$32,313 30	
And laying the large pipes between the reservoirs - - -	45,682 79	
		77,996 09
		$1,118,843 44

The whole amount disbursed from the commencement, may be arranged as follows:

First.—Croton aqueduct, reservoirs, bridges, Croton dam, etc. etc., - - -		$5,990,153 29
Second.—Iron pipes, - - - -		422,385 83
Third.—Croton water rights, - - -		13,102 25
Fourth.—Repairs on aqueduct, - -		11,499 55
Fifth.—Real estate, - - - - -		349,932 05
Sixth.—Salaries of commissioners and clerk,		43,373 85
Seventh.—Legal expenses, - - -		15,783 60
Eighth.—Laying the large pipes,	$64,617 24	
Salaries and incidental expenses of the engineer department,	191,464 26	
Incidental expense account,	5,151 11	
		261,232 61
Total expenditures, - - -		$7,107,463 03

This amount will be increased by the following sums, still necessary for the completion of the work under the charge of this Board:

The estimated cost, yet to be incurred on the Croton dam and Croton river lake; and the cost on the sections not yet completed, between Murray's Hill and the Harlem river, including the iron pipes within said limits, and the completion of the two reservoirs - - - - - - -	$572,885 00
Amount carried over, - - - - -	$572,885 00

Amount brought over, - - - - -	$572,885 00
Expense of completing the temporary connections of the aqueduct in Westchester, at the Harlem river, with the aqueduct on this island; including putting down the pipes across the river, and raising the water piers of the bridge to high water mark, with incidental work, - - - - -	116,558 00
Cost of completing the Harlem river bridge to its contemplated height, from the position of the work, where the expense necessary for the temporary crossing of the river stops, with the stone piers only carried up to high water mark, - - - -	596,779 00
Land, yet to be taken, extinguishment of water rights, etc. etc., estimated at, - -	50,000 00
Unpaid estimates for work done by contractors in October, November and December, and unpaid bills of repairs, pay rolls, etc., -	192,672 55
	1,528,894 55
Cost, as before stated, - - -	7,107,463 03
Grand total of outlay and estimated cost to finish, not, however, including pipes below Murray's Hill, nor interest, - -	$8.636,357 58

The preliminary estimate of the work in 1835, (which was, however, of a different character, and of smaller dimensions) amounted to $5,412,336 72. Shortly after getting under way, in 1837, the present Chief Engineer estimated the cost at $8,320,898, exclusive of the expense of the engineer department, (before he came into office,) water rights, and land required; and this estimate of the present engineer is still above the expenditure, and his present estimate to finish the work, about $265,000.

The Chief Engineer estimates the wants of the board in his department, for the year 1842, at $900,000. This is exclusive of lands yet required, an extinguishment of water rights on the Croton, which may be estimated at $50,000 more—in all $950,000. A considerable part of this amount is required for the settlement and liquidation, during the winter and ensuing summer, of several of the heavy contracts, and the final payments to be made on the same.

The payments of 1841, have not been as great as estimated, by $641,189. This grew out of the circumstance of several contracts not having been entirely completed, by reason of which the payments, on final settlement, have not been made.

Present state of the work.—The first division is the part of the work which embraces the Croton river dam, the artificial lake made by damming the river, and the $10\frac{117}{1000}$ miles of aqueduct, commencing at the gate house at the Croton.

Of this division, the aqueduct part is finished, and was nearly so on the 1st of January, 1841. The only part of this division remaining unfinished is the dam. After the carrying away of the earthen embankment, comprising a major part of the dam, the undersigned concurred with the engineers in the advantage of constructing the new dam on an entirely different plan from the one previously constructed; and instead of the extended earthen embankment, a continuous stone dam, laid in hydraulic cement, was decided on; to be constructed entirely across the river, so that the over fall, or apron of the dam, will be of the same extent as the natural breadth of the river The length of the new part of the dam (the mason work of the old dam not having been carried away) is 180 feet; so that with the mason work of the first erected dam, which still remains, it will make a dam of an overfall of 260 feet. The dam, when completed, will be about 50 feet high, having a base of masonry 65 feet wide; and banked in, on the up-stream side, with an embankment 250 feet wide at base. The profile of the face of the dam corresponds with the curved form which the water will assume in poring over it, and is coped with cut stone, in the most substantial manner.

At the toe of the dam, a heavy apron of crib work, 8 to 12 feet deep, and 53 feet wide, filled in with stone and planked, gives great security to that part of the work. With the view of keeping 4 feet of water on the apron at the toe of the dam, and thereby breaking the force of the fall, by its action on a body of water, there has been constructed, at a point 300 feet below the main dam, a secondary dam, of timber and stone, which is 200 feet long and 9 feet high. The abutments of this secondary dam, with two piers of crib work, filled in with stone, have been used for the purpose of a bridge across the river, and will remain a bridge to accommodate the public, and for the use of the keeper of the gate house.

The construction of the new dam was vigorously commenced by Messrs. McCullough, Black and Co., early in the spring, under contract, to raise the same so high by the 1st of November following, as to throw at least two feet of water into the tunnel of the aqueduct.

This requirement of their contract they have not fulfilled; which is to be regretted, mainly on the ground that the work could not be left in as secure a condition, against the spring floods, as it would have been left had this condition of the contract been complied with. The contractors urged in excuse, the great difficulty in procuring sufficient quantities of large stone, and of a suitable quality, and the consequent failure, by their sub-contractors, in the delivery of such stone; which difficulty was enhanced by the rejection of every stone not deemed of the most durable quality.

The work, on the whole, has been prosecuted, with the exception referred to, with commendable perseverance and energy, and the dam can be made to throw into the aqueduct the water required, early in the ensuing summer, and can be conveniently completed during the summer months.

It is presumed that the mason work of the dam, will derive additional strength from the extension of the time of its construction.

The remaining part of the aqueduct proper, in Westchester, being the second, third, and part of the fourth divisions, is completed to the contemplated gate-house at the Harlem river.

Harlem aqueduct bridge.—This work has been progressing, not as fast as was expected by the Commissioners or the engineers. To some extent the embarrassment has arisen by not finding a rock foundation in the bed of the river for pier No. 10; and after removing the mud and boulders in the river to the depth of thirty-five feet below the surface of the water, without finding rock, it was determined to place this pier on piles, and this work is now in progress. Although disappointed in not finding a stone foundation, we find the earth in the bed of the river of a compact character, and well suited to give security to the pier by piling.

The foundations for piers Nos. 7, 8, and 9 are, all of them, with their mason work, carried up above high water. Piers Nos. 3 and 4 have also been piled for masonry; and on piers Nos. 5, and 6, the masonry has been raised to eleven feet in height.

We have supposed that the details of expenditure for Harlem bridge, would be interesting to your honorable bodies, and have therefore to state, that the amount paid, from the beginning, and due to the 1st of January inst., is $210,000. The continuation of the work, sinking the remaining piers and driving the piles, mainly necessary for the proposed temporary bringing of the water across the river, and the expense of laying the pipes for that purpose, will amount to $116,558.

The estimated cost of carrying the bridge up to its contemplated height, from the point or position in which it will be, on the 1st of July next, will amount to $596,779.

After the water is introduced, by these temporary means, there will be no pressing necessity for the high bridge being erected faster than is conveninent for the resources of the coporation and the economy of its construction, provided no objection should be urged against a reasonable interruption of the river navigation, by the persons interested therein, the value of which navigation is at present, too small to be estimated.

Entertaining this view of this important subject, the Board of Water Commissioners have determined, and so instructed the contractors, that without further instructions from them, the Board of Commissioners, they, the contractors, are to do no work on the bridge, excepting such parts as may be necessary and directed by our engineers, to carry the water, on the temporary plan, across the river, and the erection of the piers of the bridge up to high water mark; and to accomplish this, will keep them busily employed until the 1st of January next. In giving these instructions, we considered we should best meet the views of our fellow citizens and the common council. If we are mistaken in the wishes of the common council, we shall be glad to be informed of the same. Under this arrangement of the work, the whole amount required by this department to bring the water to Murray's Hill, will not differ materially from $650,000, which includes the settling up the demands for work already done on the several contracts not yet completed.

Clendining valley.—The common council will recollect that we informed them, through their committee, in July, 1840, that we proposed dispensing with the arched bridges contemplated to be made by the original plan, over 96th, 97th and 101st streets. The two boards, by resolution, in 1840, approved the contemplated change. His Honor the late Mayor, fearing enormous damages would be exacted by the contractors, doubted the expediency of the measure, and deemed it his duty to veto the resolution of the two boards. Neither of the boards of the common council took into consideration the veto message of the late Mayor, that we are aware of, and as the responsibility of the work and its mode of construction was legally with this board, we deemed it our duty to dispense with the bridges in question, and the work at the Clendining valley is now completed without them.

The saving, by this alteration, has been $52,000, and a more substantial and durable work, made to supply the place of arches. We have, also, arranged with the contractors, to settle all their claims for this departure from the original plan, and for the material which they had provided for the arches, for the sum of $4,500.

The excavation of about 50,000 cubic yards of rock has been dispensed with, in the receiving reservoir, of which about 45,000 lie in the northern division. This constitutes a saving of 50,000. One dollar per cubic yard being the price for excavating.

The unfinished work on this island, is on sections Nos. 88, 89, 90, 91, 94, 96, including the receiving reservoir, 97, 98, and the distributing reservoir; all of which can be completed early in the ensuing season, a detailed account of the condition of which, is to be found in the appended report of the Chief Engineer, to which we refer your honorable bodies.

Engineer department.—Under the direction of the board, the Chief Engineer has reduced the corps to one chief, one principal assistant and two resident engineers, with the assistants and inspectors mentioned in his report. So much of the work is yet unclosed, and so many extensive calculations to be completed, and accounts written up, and withall, such is the nature of the contracts, being only for the supply of materials and labor, all to be put and applied, in the presence of and under the direction of the engineers or inspectors, that a larger number of engineers is required, than if the work was conducted on the judgment and under the direction solely of the contractors or their agents; but if a brick or stone of inferior quality goes into the work, it is the fault of an assistant engineer or inspector; and the board are of opinion that there has been great fidelity, on the part of the engineers, in the performance of their duty, rendering the work certainly equal in durability and workmanship, if not superior, to any similar work of modern times in the world.

By the absence of Samuel R. Childs, in Europe, the number of acting commissioners is reduced to four, and there is a consequent reduction in the expenses of this office.

The Board have to reiterate their increased conviction of the abundance and the purity of the Croton water supply, the aptness and ability of the aqueduct to perform its duty, the strength and durability of its structures, and the ample returns which will be realized from the same at some future period; provided, always, that the management of the work, and the collection and enforcement of the payment of the rates for water, be placed in the hands of some independent executive board, who will be likely to be more permanent in office, and rigorous in the execution of their duties, than can be expected in the yearly elected magistrates of the people.

The necessity of this vast work, on its completion, being placed under the charge of individuals devoting their exclusive and entire time to it, will be obvious to your honorable bodies. The very large amount of interest to be annually provided for, and as it is to be hoped, soon mainly to be realized out of the profits of this undertaking, will require business talent and untiring industry, by the persons having charge of the same; or, we apprehend, the citizens of New York will have to provide, *by tax*, for a large portion of the interest accruing upon the heavy cost of this work. If this interest is paid by tax, its burden will appear heavy, when compared with the amount of taxes paid by residents of other cities, which would injuriously affect the future growth of this city; whereas, if our citizens who use the water, owners of steam engines and steamboats of every discription, manufactories, ship owners, and perhaps insurance companies, were all made to pay the real worth, to them, of the water, an amount would soon be realized far exceeding the most sanguine expectations of the friends and promoters of this undertaking; and certainly surprising to those who look upon this expenditure as a mortgage on the city, without an equivalent, or reasonable return for the outlay.

In conclusion, we have to reiterate our opinion, that the water, with reasonable punctuality in payments to contractors, may be discharged into the distributing reservoir at Murray's hill, by the ensuing 4th of July; a time which, however, we fear will be altogether too soon for our citizens generally to derive advantage from the completion of the work, growing out of the vast amount of work yet to be done by them, in connecting the service pipes of their dwellings with the distributing pipes in the streets.

All which is respectfully submitted.

SAMUEL STEVENS,
Z. RING,
JOHN D. WARD,
B. BIRDSALL.

RAILWAYS AND RAILWAY SUMMITS.

It may be interesting to our citizens to present the lowest depressions of the Alleghany mountains above tide waters, in the several seaboard States, which are competitors for the western trade, derived from actual surveys.

By the South Carolina surveys, to connect Charleston with Cincinnati, by the Butt mountain gap, it is ascertained that Mr Jefferson's "backbone" rises 2,168 feet, a height which must be surmounted to pass the summit, and reach the waters flowing into the Ohio valley.

The Virginia route, after leaving the mouth of Douglass creek, or Jackson river, rise 2,551 feet, to pass into the valley of the Kenawha river.

The Maryland line of railway, to cross the Cumberland ridge, is elevated 2,754 feet above tide. To cross this summit, a tunnel, 1,808 feet above tide, has been projected.

The State of Pennsylvania, to pass the present summit at Hallidaysburg, has made her "portage railroad" of 38 miles, 2,326 feet above tide; with 10 inclined planes, and an extended tunnel, to reach Pittsburg, an immense cost. The science of civil engineering has of late discovered that Cleveland, (the head of navigation) in Ohio, on Maumee bay, can be reached in 467 miles from Philadelphia, dispensing entirely with inclined planes, and with no grade exceeding 45 feet to the mile. This route is by the Clarion summit, 1,979 feet above tide, and is now claiming the attention of the capitalists of Ohio and Pennsylvania.

The State of New York has to encounter several spurs of the Alleghany, varying from 1,200 to 1,770 feet above tide, in passing through the southern tier of counties from the Hudson river, to Lake Erie. This route cannot compare in grades and distance with the line from Philadelphia to reach Cleveland. The distance from New York, by the southern tier of counties and Dunkirk to Cleveland is 640 miles. By Albany and the line of the Erie canal to Buffalo and to Cleveland is 677 miles. From New York, via Philadelphia, making their improvements subservient to us, (by the present railroad of 87 miles,) it is 554 miles, being the shortest and best route, for all the trade and travel west of Cleveland to the city of New York.

The summit on the line of the New York and Erie railroad is near Angellica and Almond, in the east part of Alleghany county. From this point the waters divide in three different directions, namely to the south by the Susquehanna river, falling into the ocean by the Chesapeake bay—to the west and south by the Alleghany river to the Ohio and bay of Mexico—to the north and northeast, by the Genesee river, Lake Ontario and the St. Lawrence river and gulf.

The lowest depression of Mr. Jefferson's "backbone of the United States," is through the highlands, and the truly remarkable pass of the Little Falls, to reach the *long level*, on Rome summit, in Oneida county, 420 feet above tide. At this point, the waters of Wood creek commingle with those of the Mohawk river, flowing into the Hudson, the former finding their outlet through Lake Oneida, the Oswego river and Lake Ontario to the St Lawrence. The distance from the Hudson river to Oswego, on Lake Ontario, and of course by the Welland canals and upper lakes, is only 182 miles by railways, 147 miles of which are completed to Syracuse, leaving 34 miles to be completed from Syracuse to Oswego to unite us with the Canadas.

The ascent from Rome or Syracuse, by the canals, to Buffalo, the only point that can compete with Cleveland, is only 145 feet; consequently, the lowest depression for a railway to contend with "mother gravity" an item in expense that must be taken into consideration by those who seek cheap transportation.

This favored route will no doubt be made with a descending grade from Buffalo, via the Falls and Lockport, to the Hudson. The distance on this line, properly located, need not exceed 300 miles. From Albany on the east side of the river to the city hall, New York, the distance is 148 miles, with no grade exceeding 30 feet to the mile. The summit is 769 feet above tide—the average ascent 8 feet—descent 16 feet. The comparison in regard to cheapness of transportation on this line to reach the upper lakes, by Oswego, 320 miles, and by Buffalo on the short route 450—the present route, 468 miles—is too evident to need any explanation.

The city of New York, if she is true to her own interest, has nothing to fear from Boston, or her western railway. The first summit, between Worcester and Springfield, is 918 feet above tide; the second, or main summit, before reaching this State with her road, to reach the mouth of the Erie canal, is 1,440 feet above the water in the Connecticut river at Springfield; from thence, for 10 miles before reaching the summit, there are a succession of grades that range from 70 to 80 feet to the mile, the cost of transportation over which, will exceed by three times the cost over the truly remarkable route, discovered by the New York and Albany railroad company, entirely within this State.

The fact is too manifest to be disguised, that both Pennsylvania and Ohio have exhausted their credit in attempts to overcome physical difficulties in order to secure the western trade and travel. Will not the city and State of New York consider the object to which her *first* efforts should be directed? Will she not profit by the experience of others? The bubble age of speculation has passed by. We understand that it has been ascertained by careful estimates and proposals, that, with $1,000,000 subscriptions, in addition to those already obtained, a responsible body of contractors will perfect the only continuous line, by the locomotive engine, to Buffalo, from this city, by the 4th of July, 1843, and will take and hold $300,000 of the stock until after the completion of the road, as a pledge and proof of their estimation of its value.

J. E. B.

HIWASSEE RAILROAD.

We give below an exhibit of the financial condition of the Hiwassee railroad company, prepared by its Treasurer for publication. From this statement it will be seen that the total liabilities of the company amount to $211,930 29, and its present or available means to $214,504 94, or $2,574 65 more than the liabilities. In addition to this there is an amount of $150,000 yet to be called for from the stockholders, and a balance of $293,000 yet due from the State. The present and prospective means of the company, therefore, amount to the sum of $657,504 94 or to $445,574 65 over its present liabilities.

Probably a considerable portion of the stock yet due, cannot be collected; there can be little doubt, however, that sufficient will be collected to liquidate the debts of the company, at least.

We stated last week, that the company had abandoned the project of making their own iron. This we learn was a mistake. They have only suspended operations for the present, with a view to test the quality of their ore more fully, and until funds can be obtained to prosecute the work.

An impression seems to prevail that the road is to be abandoned—this idea is erroneous. The directory have only, and very appropriately, as we consider, determined to suspend, as far as existing contracts will admit, all operations for the present, and to curtail as far as possible every expense, with the view to liquidate the existing liabilities of the company. When this is effected, the work will doubtless be resumed.

We had intended to speak more at length in relation to the Hiwassee road, the plans and measures of the late and present board of directors etc., this week, but defer our remarks to a future occasion.

We would recommend an attentive perusal of the treasurer's report:

Report of the Treasurer of the Hiwassee Railroad Company.

In conformity with a resolution of the board of the 22d inst., requiring an exhibit of the *liabilities*, the present and prospective *means* of the company to meet those liabilities and to complete the road, or any portion thereof, the committee to whom was assigned that duty, respectfully submit the following *report* which presents a full and correct statement of the condition and prospects of the company.

Liabilities,—	
Due to banks,	$104,032 00
On promisory notes,	31,246 16
For checks, (scrip)	70,434 00
To contractors,	5,253 00
To officers,	965 10
	$211,930 26
Means,—	
Due on calls from stockholders,	$168,000 12
Notes of stockholders now due,	29,554 54
Real estate,	2,847 28
Machinery,	14,103 00
	$214,504 94
Showing a balance of means over liabilities,	2,574 65

And here it may be proper to state that the company is now entitled to and may expect soon to receive from the State, say $50,000 in bonds, which will add to the available means. In addition to the above, there is yet due and uncalled, from individual stockholders and from the State the following sums:

From individual stockholders, - - - -	$150,000 00
" the State, - - - - - -	293,000 00
To which add above balance of means over liabilities,	2,574 65
	$445,574 65

From the above statement, it will be seen that after paying the present liabilities of the company, there will be a balance of stock due from the State and individuals, subject to be called for at the discretion of the board any time during the present year, the sum of $445,574 65 for the completion of the road. From estimates which may be relied on, it is ascertained that this sum will be sufficient to complete the grading and lay down the superstructure of the road, from Blair's ferry to the Georgia State line, exclusive of cars, locomotives, etc. But the following statement will present the entire condition of the company in a more condensed form:

Means,—

Notes of stockholders, - - - - -	$29,554 54
Now due on calls heretofore made, - -	160,000 12
Real estate, - - - - - -	2,847 28
Machinery, - - - - - -	14,103 00
Balance due from stockholders not yet called for,	150,000 00
" " " the State, - - -	293,000 00
	$657,504 94

Liabilities,—

Amount of liabilities as above stated, - -	$211,930 26
Estimated cost of completing the road from the Tennessee river to Georgia State line, exclusive of fencing and land damage, etc., -	440,000 00
	$651,930 26

From the above statement and estimates, it is manifest that the means of the company are sufficient, not only to meet its liabilities but to finish the road to Blair's ferry on the Tennessee river. It is proper to remark, that the estimate of the amount necessary to complete that part of the road referred to, is based on the supposition, that the company can manufacture the cast iron bar at $30 per ton. That this matter may be placed beyond controversy the board have very properly determined, that all further operations connected with the iron works shall be suspended, until the quality of the ore and strength of the cast rail proposed to be adopted, be fully tested. The difficulties of the times have admonished the directory of the necessity of economising in every department connected with the road. All persons, whether officers or common laborers, heretofore connected with the company, whose services could possibly be dispensed with, have for the present been discharged, and the salaries of such as it is indispensably necessary to retain, have been reduced to an amount that will satisfy the most rigid economist.

But for the losses sustained in the bonds of the State, and the failure of stockholders, to pay their calls, (neither of which could be anticipated by the board) no debt would now be owing by the company. When the States's subscription was made, all believed that the bonds would command their par value. That such was the belief of the legislature is proven by their carefully reserving to this State, any premium they might command, and providing for no loss. Our company have, however, after seeking the best market, lost upon the State bonds already received $77,000 or over one-fifth of the whole amount. To make up this defici' and in anticipation of payment from stocholders, the present liabilities have been incurred. These liabilities must be met. If stockholders will pay their liabilities, this can be done. If they will not, the recent resolution of the board to place them immediately in a train for collection, should be carried into effect. Justice to those stockholders who have paid their calls, to creditors, to those individuals who are under liabilities for the company, and to the public, demand this course. Too much money has already been expended on this road to be lost. The present and prospective interests of East Tennessee are too intimately connected with it to think of its now being abandoned. And if the stockholders will but second the endeavors of the directory, if they will comply with pledges which they are both legally and morally bound to redeem, all that energy and economy can effect, will be done speedily to complete this important public work.—*Knoxville Register*

The Internal Improvements of Ohio.—The following is the condition of internal improvements of Ohio. The Muskingum improvement is finished. The Hocking canal is all finished except ten miles. The sum of $200,000 will complete the Wabash and Erie canal. Eighty-eight miles remain to complete the Miami canal extension from Cincinnati to the Maumee bay, and will cost $900,000; the entire length including navigable feeder, is 111 miles. When these works are completed, there will be within Ohio, 914 miles navigable canal. The income of the canals this year, paid into the treasury, has been $484.753,18, which will already pay the interest on over $8,000,000 of debts.

Prevention of Rust.—The prevention of rust on such articles of furniture as are made of pollished steel is an object of great importance in domestic economy. The cutlers in Sheffield, when they have given knife or razor blades the requisite degree of polish, rub them with powdered quick lime, in order to prevent them from tarnishing, and it is said that articles made of pollished steel are dipped in lime water by the manufacturer before they are sent into the retail market.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 7, Vol. VIII. New Series.] APRIL 1, 1842. [Whole No. 403. Vol. XIV.

[For the American Railroad Journal and Mechanic's Magazine.]

REMEDY FOR THE EMBARRASSMENTS OF PENNSYLVANIA.

"*The times are hard, and a lack of confidence, and bankruptcy prevail in an unusual degree.*" !!

The embarrassments of Pennsylvania have brought out one of her patriotic sons to devise the best means to extricate her, and which he has addressed formally by pamphlet to Governor Porter, proposing an amphibious or mixed order of transportation by railway and canal between Philadelphia and Pittsburg. The following is an abstract of his *requisitions* for carrying out this plan, which to be feasible, however, *only requires* that these requisitions be as easy to comply with as it is to swallow Dr. Brandreth's pills. Like the latter, to our mind, it savors no little of quackery, and as we have never heard of its being ever entertained at head-quarters, we infer it has been there so regarded. The author is evidently of the old or canal school, of whom it may be now asked, as of the Bourbons, "that while they forget nothing, neither do they learn anything." Specimen as follows:

1. *It only requires* to enlarge the locks of the Pennsylvania canals to 120 tons, to widen the bottom and to add another pair of gates,—all at a cost of $5,000 per lock, to effect a reduction of the toll and freight from 2 down to 1 cent per ton per mile, with a fair profit to the boat owner.

2. *It only requires* $3,000 per mile to lay a light railway on the banks of the canal, already graded for it, except for about a quarter

of a mile at each of the locks where the rise would be 40 to 50 feet per mile, between Columbia and Pittsburg, 269 miles.

3. *It only requires* the vigorous completion of the above plans at a trifling expense of only $1,677,000, and in the short time of only one year, to defeat the schemes now carrying on at great expense by New York, Baltimore and Boston, to take from Pennsylvania the western trade; and thus would her credit be at once raised and her debt wiped off, and the world convinced that she is really the keystone of the arch.

4. *It only requires* to make the boats on the fish plan in sections or links, overlaying each other like scales, and to be put together with all the ease of slipping the cover on a snuff-box, and these sections to follow the increase of trade so long as there is plenty of water and business.

5. *It only requires* this cheap kind of railway to answer all desirable and profitable purposes for an age to come, in place of the present fashionable high priced ones, by placing them on the tow path or berm bank of the canal, nine-tenths of the expense or grading of a railway is saved; and this union of the two improvements would attract business by allowing the trader to see the boats as they pass on the canal with his treasure and living, and how much would his desire to travel be incited and his delight enhanced, by the long vista of canal before him covered with deeply laden barges constantly wending their way to his favorite city or the far west. Two ton locomotives would here afford all the accommodation that is now afforded on the expensive roads suited to those of 12 tons, and there is, therefore, no reason why Pennsylvania should not occupy at once her vantage ground by making this her GREAT WESTERN RAILWAY connected with and appurtinent to her canals, to be got ready in a single year on the cheap but appropriate plan of not spending ten dollars when only one is enough.

6. *It only requires* to increase the power *sufficiently* at the inclined planes on the Portage road, to give them the facility of passing millions of tons per annum.

7. *It only requires* to contract the channel of the Ohio river to about 100 feet in width, by means of wing and channel walls to make it navigable and safe at all times.

8. *It only requires* the enlargement and doubling of the locks above proposed, to give the canals a capacity of six millions of tons, and of nine millions of tons by tripling them, and by deepening them one foot, one-third more would be added to their capacity, sufficient it is presumed for the present generation,—the next may

substitute the balance lock, and then their capacity may be increased fifty fold.

9. *It only requires* to cover the exposed parts with paved and sloped walls, and where they leak to lay the toe of the stones in a bed of hydraulic concrete, and to secure all the works with hydraulic lime mortar, to make our canals entirely free from breaches and risk,—reducing the expense to only $50 per mile, or rather exempting them entirely from repairs for hundreds of years.

10. *It only requires* to apply the waste water at the 174 locks on the canals between Columbia and Pittsburg, to iron furnaces, mills and other manufactories, to create a freight from the canal itself of 2,610,000 tons, the tolls on which, alone, independent of those on other produce, would be equal to paying off the whole cost of canal; but apart from this, the modification of our works as here proposed, would, no doubt, bring on them for the first year, 1,000,000 of tons and 60,000 passengers, the nett tolls on which would amount to $3.007,500 on this one single link between Philadelphia and Pittsburg; and the other divisions arranged after the same manner, would also become very profitable; and this source, over and above the business created by the canal itself, would also, in ten to fifteen years, liquidate the cost of these works.

11. *It only requires* the possession of canals, and railways follow nearly as a gratuity, nine-tenths of their cost being paid for already in the grading of the canal, and the cheap but appropriate ones here recommended to be laid on the tow paths, should be at once adopted, if it be possible to remove the *prejudices of the times in favor of the dear and heavy ones* made in the vain ambition to take the heavy freights from the canals.

12. *It only requires* to find purchasers for the water power of the 174 locks on the canals, equal to 10,440 horses, (and water power is cheaper and steadier than steam,) to make it yield a rent to the State of at least $288,000 per annum; with our water power thus employed, our work-shops would be at home and not in Europe.

It is not provided in this scheme at what speed the railway is to travel, but all the arrangements indicate that the tortoise and hare are to be harnessed together, and that the cars and boats are to keep company, if they can, at the canal rate, of about three miles per hour. The rival lines, however, from New York, Baltimore and Boston, which this scheme is designed to supercede, all having provided themselves with the means of going at a rate of at least ten miles with goods and twenty miles with passengers, would be the most likely to absorb all the business, leaving the Pennsylvania scheme to find out that the cheapest is not always the most economical plan, but is most frequently the greatest pickpocket, and all *experience* goes to show that this is most particularly so with railways.

It would perhaps have been unnecessary to allude to this scheme, but that the light railway portion of it is attempted to be brought again into favor, and which we think should be opposed as very ill advised. We have never, however, believed in its obtaining any advocates, because it is founded on a basis at which the people will be sure to revolt,—that of making the cost of the provision for safety, despatch and accommodation, exactly commensurate with the amount of travel which may be reasonably anticipated; thus making different standards by which the lives and convenience of travellers are to be estimated according to their number, which must ever be a matter of the merest guess work.

What Pennsylvania really wants, is Mr. Schlatter's middle route of railway to connect Philadelphia with Cleveland, by which the western traveller could be put sure twelve hours sooner into New York city, passing through Philadelphia, than by any other route; but as desirable as this supremacy may be to her, we trust she will never attempt it, except by an improvement of the most permanent and distinct species.

To make the *shortest time* is now to win the race,—the canallers to the contrary notwithstanding.

We have received, through our friend, Joseph E. Bloomfield, "The proceedings of the Western railroad corporation, of 21st January, 1842," and the following extracts of an "Address to the people of Msasachusetts," by that indefatigable friend of railways, Mr P. P. F. Degrand, "was read and unanimously adopted."

Mr. Degrand, with great propriety, rebukes the Government of the United States for its parsimony and desire to take advantage of private enterprise, without an adequate compensation, compared with the benefits received. It is stated that the line of railways from Boston to Albany, has cost upwards of $9,000,000, built without any aid from the Post Office Department, but in view, no doubt, by the corporators, of receiving the modicum of $300 per mile per annum, allowed by the present law of Congress, a sum, if we are correctly informed, about half the rates paid by the British Government to their private railroad incorporations, on *main lines*, such as the Western railroad must be considered. This road is one of much importance to the General Government for our sea-board defence. It will connect us at West Troy with the principal depot for arms, guns and the manufacture of gun carriages, in the United States. On the east, by the Western railroad, it will unite us with the United States' armory, at Springfield, Massachusetts, thus rendering the cities of Boston and New York impregnable to foreign invasion. The query is very properly made by Mr. D., "How unreasonable then, has it been for the Post Office Department to hold up to public obloquy the price asked by the Western railroad for the transportation of the mail, on the ground that *it was higher than the charge by the stage coaches.*"!!

We were struck with the delicate flattery administered to our legislature, and to the canal interest, to induce them to take off all restrictions on the line of railroads parallel to the Erie canal,—Mr. D. observes:

"The enlightened friends of the Erie canal, a work of infinite good, cannot allow themselves to sustain a restriction so clearly inconsistent with the spirit of the age.

"A simple suggestion to the legislature of New York, from the legislature of Massachusetts, will doubtless suffice to produce the desired effect."

Following this address, we find our legislature have been invited by the Western railroad company to meet the legislature of Massachusetts at Springfield, to give them this suggestion. We Van Winckles certainly require some hint of this kind to *enlighten* us. We consider the Western railroad has been built as much for the advantage of the city of New York as of Boston, and we will hold up both our hands in favor of the present legislature taking off all restrictions on the railways, parallel to the Erie canal, whereby the western trade may be turned into the lap of Boston.

It would appear that our rich capitalists and property holders require a spur of this kind, to take up and complete the *New York and Albany railroad*, the only work than can *immediately* head off our enterprising neighbors. We have too long depended on the natural advantages of the Hudson river. How important and profitable to us to have an *iron* avenue, a *second Hudson river*, to connect us with upwards of one thousand miles of railways that will be finished by July next, extending from Portland, in Maine to Buffalo, intersecting the Boston and Albany railroad, distant 117 miles from this island, in Chatham, Columbia county. We understand that subscriptions have been tendered to our citizens from the country to complete half this distance. Why then do we delay the work? The stock must be a profitable investment, inasmuch as a great city, with near 400,000 souls is at the southern termination for travel and traffic with the whole of New England,—the Canadas,—with near 1,000,000 of souls in our own State, and the millions beyond it, will seek us *at all seasons*, if we afford them the same facilities now held out by Boston. With a railroad *direct* to Albany, we may consider the *Western railroad* built for the especial profit and convenience of the city of New York.

"WESTERN RAILROAD ADDRESS.

"*To the people of Massachusetts:*

"FELLOW CITIZENS: Thanks to the enlightened forecast of the legislature of Massachusetts, your ardent and patriotic desire of reaching by railroad, the mouth of the Erie canal, has been accomplished. We have now secured, for all time, to Massachusetts, as well as to New England, whose trade centers in our own State, the best line of communication to the great west, which the light of the age has given to mankind. Let us render thanks to a kind Providence, that we have been enabled to accomplish this great national purpose, in a very brief space of time, in the midst of unparalleled difficulties in the money market and through chains of mountains, which seemed to present insuperable obstacles.

"The line of railroad between Boston and Albany, with its numerous appended communications by steam, in all directions, all over New England, forms a web, which, without cost to the nation, defends almost every harbor in New England, and some even out of New England. Placing at every point, even to the frontiers of Canada,—the power of commanding, with great celerity, the concentration of a great force, this web warns foreign powers of the futility of any attempt to make a lodgement on our territory, and is not only our best defence in war, but also, and emphatically, our best negociator for the preservation of peace.

"FELLOW CITIZENS: Amidst the wreck of State credits, in all directions, the credit of Massachusetts has stood unshaken; and now the completion of the communication to Albany by the Western railroad furnishes the additional guarantee of the revenue of that road, to meet the interest and sinking fund of the $4,000,000 debt, contracted by the State in aid of this great work.

"We are, however, forewarned by the times, that it is highly important to adopt every measure in our power, which may have a natural tendency to decrease the total amount of our State stocks.

[Here follows plan of a sinking fund.]

"FELLOW CITIZENS: By means of the Western railroad, a great national work,—constructed without the slightest disbursement by the Treasury of the United States,—a very powerful fleet can, in a few days, (of winter as well as summer) be equipped on Lake Erie, on Lake Ontario, on Lake Champlain,—with materials, munitions of war, workmen and seamen, brought from the Charlestown navy yard.

"FELLOW CITIZENS: The Western railroad, between Worcester and Albany, will, with a single track, cost, - - - - - -	$6,700,000
Add to this, the cost of the Boston and Worcester railroad, - - - - - -	2,300,000
And we have an expenditure of, - - -	$9,000,000

For the line of 200 miles of railroads, between Boston and Albany. These railroads form the only link, on which the land mail can be transported, in a way satisfactory to common sense, either between Boston and Albany and places right and left of the road,—or between Boston and New York, as far as Springfield,—or even between Albany and New York city, in the winter, as to some portion of the Western railroad. This line of railroads between Boston and Albany, has been constructed without any contribution from the Post Office Department. The cost of these 200 miles of railroads and of their repairs, is borne by their stockholders. How unreasonable then, has it been for the Post Office Department to hold up to public obloquy the price asked by these railroads for transporting the mail, on the ground that it was higher than the charge by coaches!

In the case of the coaches, transporting the mail on the common roads, the interest on the cost of these common roads, cost to the coaches, nothing, say,	$00 00
The repairs of said common roads, cost to said coaches,	00 00
Total cost, to the coaches, for construction and repairs of the common roads, on which they carry the mail,	$00 00

Now let us see how the case stands, as to the railroads:

The interest on the above $9,000,000, which is their cost, at 6 per cent. per annum, is, - - -	$540,000
Repairs annually, - - - - - -	60,000
Interest and repairs, annually, - - - -	$600,000

"Is it reasonable, then, to compare the charge by coaches, to the charge by the railroads, and to say nothing of this annual difference of $500,000?

"Suppose that these railroads should say to the Post Office Department, 'just do for us *gratis*, what is done *gratis* for the coaches,—and we will transport the mail, for nothing!'

The result would be an annual payment, by the Post Office Department, of, - - - -	$600,000
Whereas, the railroads are content to take, at present, what the law allows the Post Master General to pay, viz.— - - - - - -	60,000
Thus making every year, a saving to the United States, of, - - - - - -	$540,000

"Fellow Citizens: The nation spent several millions, in constructing the Cumberland road to insure the transportation of the mail, as well as to insure other national purposes, which are better performed by the railroad system. Is not the interest on the cost of the Cumberland road, or some portion of that interest chargeable, as a part of the cost of transporting the mail, by coaches, on the Cumberland road?

"Shall, then, the people of Massachusetts, who, as stockholders, own one-third of the Western railroad, and who have loaned $4,000,000 upon it, make no effort to impel the Post Office Department to give to it a suitable compensation, for the transportation of the mail,—a compensation having some sort of reference to its great cost and to the cost of its repairs? Or shall their voice be heard, in favor of a suitable remuneration, for all this capital and for the risk incurred in embarking this capital, in a scheme which many deemed, until now, very hazardous? Shall the press speak? Shall the legislatures of Massachusetts, of New York, and of the great west (to whose citizens the Western railroad, for all practical purposes belongs.) speak and request their Senators and Representatives in Congress, as well as the President of the United States and his cabinet, to cause justice to be done by the Post Office Department to a work so highly useful to the whole country, and in which the people of Massachusetts have so deep an interest in every point of view?

"Fellow Citizens: In interchanging resolves, at a very early period, and in the various steps of legislation which led to the building of the Erie canal, and more especially of the line of railroads from Massachusetts Bay nearly to Lake Erie, the legislature and the people of both Massachusetts and New York States could not but have in view to secure for western New York, during the 4 winter months, as well as for the other 8 months of the year,—a commercial and a social existence,—to secure, for that great, populous, thriving, industrious and growing portion of the State of New York, access to the sea, throughout the year. The restriction, as to carrying freight, on a portion of the railroads parallel to the Erie canal, is clearly inconsistent with this beneficent original intent. The enlightened legislature of New York will doubtless perceive (the very moment its attention is called to the subject) that the time has now arrived, when the public interest, as well as even handed justice to western New York, requires that this restriction be taken off, even if it should be deemed proper to accompany this permission to take freight, by a moderate toll, charged to the railroads, on such freight, for the benefit of the canal fund. It surely cannot be the desire of an impartial legislature to confine to the neighborhood of the single city of Albany, the winter access to the markets of the whole world. To deny this access, is to decree four months of comparative idleness;—to decree the loss of the best time to sell, for a vast amount of agricultural products, and of the best time to buy, for a large amount of goods from New England and from abroad. It is to decree the loss of four months' interest on the enormous amount of the winter supplies, and of the sales of agricultural products, which will be made in the winter, if the law permit. Whatever might be said, in favor of the restrictive policy, while Albany had no winter-access to the ocean, disappears, now that the promethean heat of locomotive fire has given her life during the dead season. The winter is the time when fresh fish and fresh provisions can be transported freest from the danger of being spoilt. It is the time when the farmer is most at leisure and when he can, most conveniently, visit the seaboard with his produce and his family and select such returns as he may desire.

"The enlightened friends of the Erie canal,—a work of infinite good,—cannot allow themselves to sustain a restriction, so clearly inconsistent with the spirit of the age.

"A simple suggestion to the legislature of New York, from the legislature of Massachusetts, will doubtless suffice to produce the desired effect.

"Fellow Citizens: We cannot forbear adverting to the uniform kindness and enlightened spirit, with which the mayor, council and people of Albany, and indeed the governor, the legislature and the people of the State of New York have cherished every step of our great enterprise. They have had a just conception of its immense advantages to both States and to the whole country. Indeed the Commander in Chief of the State of New York ordered a national salute of 26 guns to be fired, in commemoration of the opening of the Western railroad, as an event greatly contributing to the defence of the country and to cementing the Union. The recent personal exchange of the most cordial feeling, between a large body of the citizens of Massachusetts and a large body of the citizens of Albany, Hudson, Troy, western New York and other parts of that great State,—will be ever remembered with gratitude to that Supreme Being, who thus cemented bonds of friendship which must have a most salutary effect on the whole of our beloved country, and which we trust will endure till time shall be no more.

[For the American Railroad Journal and Mechanics' Magazine.]

CHAMPLAIN AND ST. LAWRENCE RAILROAD COMPANY.

"Extracts from the proceeding of the half-yearly meeting of the stockholders of the Champlain and St. Lawrence railroad company, held on Monday, the 17th instant, at the office of the company:

"William Connolly, Esq., was called to the chair, and Mr. W. D. Lindsay, acted as secretary.

"John E. Mills, Esq., as chairman of the committee of management, made the following report, which was received and adopted by the meeting:

"*Chairman's report to the stockholders.*

"Gentlemen: The statements which we now have the honor to submit to this meeting cannot but be highly satisfactory to the stockholders of the company; and notwithstanding the difficulties we had to encounter last season, arising from extreme low water and loss by incendiarism, we are enabled this day to declare a dividend, payable on 1st of February next, of eight per cent. upon the capital paid in, besides leaving a contingent fund of £2,104 for future operations. This result must fully prove the capabilities of the company, and confirm the value of our stock in the estimation of the public.

"We refer you to the commissioner's report for more general details, and will merely call your attention to that part of it which refers to the Laprairie ferry, and recommend our successors in office to give the improvements suggested upon this portion of our line of communication their serious attention, as of the utmost importance to the interests of the company.

"While the public prints are almost daily recording casualties on other railroads, we are most happy to have it in our power still to congratulate the stockholders and the public upon having been so far favored by the absence of all accident involving the safety of passengers transported over our road.

"It also gives us much pleasure on this occasion to express our entire satisfaction at the manner in which the officers and servants of the company have discharged the duties of their respective stations.

"JOHN E. MILLS, *Chairman.*

"*General statement.—*

Gross receipts of 1841, - - -		£14,000 0*s* 0*d*
Current expenses, - - - -		8,758 14 7
Nett gain 1841, - - - -		£5,241 5 5
Contingent fund on hand, January 18, 1841, - - -	£2,177 8*s* 10*d*	
Out of which laid out for additions and improvements, -	2,114 3 5	
		63 5 5
Total amount at disposal of the company, - - - -		£5,304 10 10
Out of which a dividend of 8 per cent. is declared upon the capital stock paid in—£40,000—is - - - -		3,200 0 0
Contingent fund carried to 1842, - -		£2,104 10*s* 10*d*

Number of passengers in 1841, - -	26,357
Tons of goods and lumber, - - -	12,614

"W. D. LINDSAY, *Commissioner.*

"RAILROAD OFFICE, MONTREAL, *January* 17, 1841."

The above railway is 15 miles long, and the ferry traversed is 9 miles. The maintenance of the latter is very expensive, as the rapid to be overcome in ascending, is one of the severest, if not, indeed, the very worst, in the country.

The following abstract of current expenses has been furnished by Mr. Lindsay. The road has been in operation 6 years, but for the first 3 years the accounts were kept in a different manner.

HEADS OF EXPENDITURE.	1839.	1840.	1841.	Average.
Motive power, - - - -	£710 18s 10d	£731 9s 11d	£856 1s 7d	$3,064 69
Repairs of cars, - - - -	338 14 40	420 2 00	409 3 2	1,490 63
Maintenance of way, bridges and buildings, - - - - -	894 10 9	580 18 5	940 9 9	3,221 29
Expenses of freight department, -	508 7 7	570 2 3	747 4 7	2.434 29
Incidental expenses, - - -	743 8 7	1,029 3 10	731 5 3	3,338 48
Expenses of wharf at St. John's,	– – –	138 16 5	106 1 3	489 72
Interest account, - - -	713 14 11	461 18 2	422 11 10	— —
Salaries of officers, - - -	1,187 00 00	1 535 13 11	1,564 10 00	5,716 26
Expenses of steamboat, - -	2,399 18 5	2,652 9 3	2,981 7 2	— —
	£7,496 13s 5d	£8,120 14s 2d	£8,758 14s 7d	$19,755 36

The total expenses are, therefore, $1,317 per mile, and the repairs of railway, bridges and buildings, are $214 75 per mile, per season of 7 months.

Adding the sum, due to the interest, to the paid up, capital $160,000 (£40,000) and we have $188,173 as the entire capital invested. This includes a steamboat and several barges for towing, deducting the value of which, the cost of the road, fixtures etc., would be nearly $11,000 per mile, including wharves costing $15,000.

The total cost of right of way, graduation and superstructure for 15 miles including 2 engines, 6 first class passenger cars, 50 freight cars, depots, shops, platforms, woodyards and water stations is $10,000 per mile.

For the first 5 years, the road earned 10 per cent. per annum; during which time the wooden rails were all renewed and the spikes for the plate-rail replaced by new and better ones, made by hand, of refined iron. These were not only far superior to, but were actually cheaper than, Burden's spikes, which had been previously used.

Freight and passengers are carried in the *same* train, at the rate of 15 miles per hour, and the trains are seldom *full*. It is obvious that the success of the road is due to the economy of its construction, for, with a substantial track, the dividends would have been reduced one-third. On the other hand the expenses are necesarily great, as all the freight is handled three times, and a large force must be kept at the wharves in readiness for the business which is exceedingly irregular. The management of this road and ferry is about as expensive as, and much more difficult than, the management of a continuous railway of 50 miles, or perhaps 100 miles, doing merely a passenger business. Considering that the freight yields a large portion of the income, the management of this little railway will compare favorably with that of any road in this country.

W. R. C.

New York, *March* 16, 1842.

[For the American Railroad Journal and Mechanics' Magazine.]

RAILROADS VS. CANALS.

A remarkable illustration of the capability of railroads to compete successfully with canals in the transportation of *freight* appears in the history of the Boston and Lowell railroad. This road runs in a directly parallel line with the Middlesex canal, 25¾ miles; it was constructed at a time when experience had given little practical knowledge to contractors or engineers, and its cost when completed, with a double track, amounted to the enormous sum of $71,000 per mile. Notwithstanding these great disadvantages, it appears from the annual report made under oath to the legislature of Massachusetts, that the company has divided annually for the last five years an average of 7⅝ per cent., reserving at the same time out of the nett income, a fund sufficient to keep the road in complete repair, and to renew the track when required. It also appears that the amount of income derived from freight has been rapidly increasing during the last five years, having amounted in 1837, to $63,137, and in 1841, to $121,588. The income from passengers has also steadily increased, but not in the same ratio, having been in 1837, $117,643, and in 1841, $145,953. The principal part of the income from freight on this road is derived from the transportation of cotton in the raw and manufactured state; and what will be most surprising to a New Yorker, is the fact, that since this road has been in operation, the use of the Middlesex canal, *running in a directly parallel line, and terminating at the same points*, has been almost wholly discontinued.

As a further illustration of the profits to be derived from the transportation of freight on railways, it may be stated that the *Lowell and Nashua* railroad, 14 miles in length,—a continuation of the Boston and Lowell railroad,—took, in

1837,	from passengers,	$36,647,	from freight,		$18,405,
1841,	" "	75,732,	"	"	56,761.

The freighting business having more than trebled in three years, while that from passengers did not quite double. The dividends on the Nashua and Lowell railroad in 1839, was 6½ per cent., 1840, 7½ per cent., 1841, 8 per cent.

As a stronger proof of trade and travel deserting a canal in a populous and manufacturing district, it may be stated, that since the completion of the Boston and Providence, and the Boston and Worcester railroad, the Blackstone canal has fallen into disuse, inasmuch as valuable manufactures, and their raw material in cotton seeks the Boston and Worcester railroad and the Boston market, in preference to the Providence market. In this case, the introduction of railways has changed the market and mode of transportation.

On a former occasion, I noticed the decline of the Farmington and Northampton canal, parallel to the New Haven and Hartford railroad and Connecticut river, since the improvement of the latter.

The great contest for superiority, between railways and canals, judiciously located, is about to be submitted to a fair test this season, in the transmission of a bulky article, coal, from Pottsville to the city of Philadelphia, and without any reference to passengers, the only object for which many contend that a railway should be constructed.

It is much to be regretted that our legislators heretofore have been so wedded to canals, that they would not examine into the comparative merits of railways. Is it because our State is so largely interested in canals, that our public officers consider it their duty to protect canals by a tax on private enterprise, even if they tax the people to carry out works, that may share the fate of the Middlesex, Blackstone and Farmington canals?

J. E. B.

PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS.

Experiments on the strength of iron girders. *By* THOMAS CUBITT, *Assoc. Inst. C. E.*

This communication gives in a tabular form the results of experiments upon upwards of 60 pairs of cast iron girders, varying in length between 7 feet 6 inches and 27 feet, with corresponding depths, and of all the forms usually adopted for beams for buildings. They were proved in pairs by a hydraulic press placed between them, the ends being retained by wrought iron ties. The deflexion was noted at each increase of pressure, and in many instances the beams were factured.

Sketches of the girders, and of the apparatus used for proving them, accompanied the paper; from them five drawings have been made at the institution, to facilitate a reference to the information contained in the communication.

Description of an improved level and stand. *By* G. TOWNSEND.

This improvement being intended to procure a firmer basis and greater facility of adjustment than by the ordinary level, the author has adopted the principle of the triangular plate, with three levelling screws. In the ordinary instrument, with two pairs of screws, it has been found that the antagonist screws, besides being apt to wear unequally, and to indent the lower plate, are sometimes bent, and thus cause an unequal action upon the upper plate. To obviate these defects, the screws in the tripod level are made to work into inverted cones, which are fixed in the three grooved arms of the stand head; the weight is more equally distributed, and the telescope more speedily brought to a level.

The telescope is fixed to the levelling plate by an upright limb, and to this is added a small longitudinal cross level, as in Gravatt's instrument. In the improved stand, each of the legs is attached to two arms of the lower tripod plate, by which means a firmer basis is obtained. The usual locking plate, to secure the levelling screws, is also attached to this instrument, and kept in place by a spring catch; there is also a metal ring fixed on the upright limb, above the arms, and which falls into three spring catches in the table plate, by which any derangement from accidental violence or in removal from one station to another, is effectually prevented.

A small circular spirit level is fixed in the stand in order to adjust it before the instrument be placed on it, by which means the labor of adjustment is considerably abridged.

Memoir of the Montrose suspension bridge. By J. M. Rendel, *M. Inst. C. E.*

Previous to the year 1792, the passage of the river Esk at Montrose was effected by common ferry boats; at that period an act of parliament was obtained for the construction of a wooden bridge, with numerous arches, or rather openings formed by beams, supported upon piles, with stone abutments at either end; the action of the tide undermining the piles, and the usual progres of decay causing great expense for repairs, it was decided in the year 1825, to erect a suspension bridge, the iron work of which was contracted for by Captain Samuel Brown, R. N., for the sum of £9,430, and the masonry of the towers for £9,080. The total cost being £18,510, exclusive of the land arches and approaches; those of the old bridge being preserved for the new one.

The dimensions of the new bridge were:—

	Feet.
Distance from centre to centre of the towers, - -	432
Deflection of the chain or versed sine of the catenary, -	42
Length of the suspended roadway, - - - -	412
Width of ditto, - - - - - -	26
Height of ditto above low water, - - - -	21
Ditto of the towers above ditto, - - - -	68
Base of the towers at the level of the roadway, -	40 by 20
Archways through the towers, - -	16 wide, 24 high

The towers were built of red sandstone ashlar, raised on a base of the same material, carried upon piles.

Construction.—There were two main chains on each side, arranged above each other in parallel curves, 12 inches apart. Each chain was composed of 4 bars of iron, 5 inches wide by 1 inch thick, and 10 feet long, united by short plates and strong wrought iron pins. The roadway was suspended to these chains by perpendicular rods, $1\frac{1}{4}$ inch in diameter, attached at intervals of 5 feet, alternately, to the upper and lower lines of main chains, at the joints, which were arranged so that those of the upper chain should be over the long bars of the lower one; at the lower end of each suspending rod was a stirrup, which received and carried the cast iron bearers for supporting the roadway.

Upon these bearers was laid and rivetted longitudinally a flooring of fir planks, 3 inches thick, and well caulked; upon this a sheathing of fir, 1¼ inches thick, was placed transversly, and spiked to the lower planks; over all was spread a coating of about 1 inch thick of fine gravel and sand, cemented with coal tar.

The suspending rods were without joints. The main chains rested upon detached cast iron saddles, built into the masonry of the towers, and passing down at either extremity, were secured behind cast iron plates in masses of masonry, 10 feet under ground.

The construction was commenced in September, 1828, and was finished in December, 1829, a period of only sixteen months.

Accident to the bridge.—On the 19th of March, 1830, about 700 persons assembled on the bridge to witness a boat race, when one of the main chains gave way, and caused considerable loss of life. The injury was speedily repaired, but a careful survey of the structure was ordered, and it was discovered that the intermediate or long links of the chains bore so unequally upon the saddles as to be bent and partially fractured. Mr. Telford, who was consulted on the subject, proposed the addition of two other main chains placed above the original ones, and having the same curve, so as to increase the sectional area 40 inches—thus, giving 6 chains of 20 inches area each, instead of 4 chains, as originally constructed.

Mr. Telford's decease occurring at that period, the author was instructed to report upon the state of the bridge, and advise such alterations as he judged to be necessary.

After a minute personal inspection he concurred in Mr. Telford's idea of the necessity of increasing the strength of the bridge, but instead of augmenting the number of the chains, he advised the addition of two bars in width to each of those existing, by which means the required strength might be gained. He was led to this by an opinion that, in all cases, it is desirable to have as few chains as possible.

It appeared that there had been but little precision in the workmanship of the chains; for on releasing them they immediately became twisted; thus showing that all the links had not a true bearing. On taking them apart, many of the traversing pins were found to be bent, and some of them were cut into, evidently, by the friction of the links. This was to be rectified, and new saddles of a different principle and stronger form were recommended: also, that those parts of the chains which rested in the saddles should be entirely composed of short plates. Additions to the masses of masonry holding the chains were likewise deemed advisable.

Between the years 1835 and 1838, all the principal works, with many minor improvements, were executed.

In the author's report on the state of the bridge, he noticed what he deemed defects in the construction of the roadway, but as there was no positive symptom of failure, it was allowed to remain. He conceived, that in the anxiety to obtain a light roadway, mathematicians and even practical engineers had overlooked the fact, that when lightness induced flexibility, and consequently motion, the force of momentum was brought into action, and its amount defied calculation.

On the 11th of October, 1838, the roadway of the bridge was destroyed by a hurricane, the effect of which upon this structure is the subject of a paper by Colonel Pasley, published in part 3, volume 3, of the transactions of the Institution C. E. To that account the author refers for the principal details, only adding, that on inspecting the bridge, he found the chains, the saddles, and the fastenings or moorings, quite sound; the principal portion of the roadway had been completely carried away, and the remainder much injured. He then gives some account of the undulatory motion observed during the storm. This motion was greatest at about midway between the towers and the centre of the roadway; but the waves of the platform did not coincide with those of the chains, either in magnitude or in order; no oscillatory motion was perceived either in the roadway or in the chains, although particular attention was directed to them.

It appears that the centre of the platform fell in a mass. This the author attibutes to the failure of the suspension rods, which, having no joints, were twisted off close to the floor by the undulatory motion. A similar occurrence at the Menai bridge induced Mr. Provis to adopt the joints in the suspension rods, which the author had previously introduced at the Montrose bridge.

The author had long been convinced of the importance of giving to the roadways of suspension bridges the greatest possible amount of stiffness, in such a manner as to destribute the load or the effect of any violent action over a considerable extent.

The platforms of large bridges, in exposed situations, are acted upon in so many different ways by the wind, that he had an objection to the use of stays or braces to counteract movements which ought rather to be resisted by the form of the structure.

Holding such opinions, he determined to adopt a framing which, although connectedly rigid in every direction, should nevertheless be simple, composed of few parts, capable of being easily renewed; should distribute its weight uniformly over the chains; not be subject to change from variation of temperature, and not augment the usual weight of suspended platforms.

The details of the alterations, and general repair of the bridge, are then given; a few may be mentioned.

An entirely new set of stronger suspending rods was introduced; they were $1\frac{5}{8}$ of an inch in diameter down to the flexible joint at the level of the platform; below that point the diameter was increased to $1\frac{3}{4}$ of an inch, and a strong thread was cut on to the lower end, so as to adjust them to the requisite lengths.

In the place of the cast iron bearers, cross beams were substituted, composed of two Memel planks, 13 inches deep, $3\frac{1}{2}$ inches thick, bolted together, and trussed with a round bar $1\frac{1}{8}$ inch diameter; every sixth beam had a deep trussed frame on the under side, so as to give great stiffness. Above and beneath the cross beams, on each side of the carriage way, were bolted two sets of longitudinal timbers, four in each set; they were further united by cast iron boxes, at intervals of 10 feet; and the ends were secured to beams of English oak, built into the masonry of the towers. A curb of Memel timber, 11 inches by 6 inches, was attached to the ends of the cross bearers, and extended the whole length of the platform.

The planking of the footways was composed of narrow battens, 2 inches thick, laid transversely from the inner longitudinal beam to the outer curb piece, with an inclination or drip of 1½ inch in 5 feet.

The carriage way was formed of four thicknesses of Memel plank; the two lower layers, each 2 inches thick, were placed diagonally with the transverse beams, crossing each other so as to form a reticulated floor, abutted against the longitudinal beams; they were firmly spiked to the beams, and to each other, at all the intersections, and upon them was laid and spiked a longitudinal layer of Memel planking, 2 inches thick. Over the whole was fixed, transversely, a layer of slit battens, 1¼ inch thick. Each layer was close jointed and caulked, and the upper one was laid in a mixture of pitch and tar. A composition of fine gravel and sand, cemented with boiled gas tar, was laid over the whole, to the thickness of 1 inch, forming the road track.

To add to the stiffness afforded by this construction, the author caused to be passed through the spaces between the pairs of longitudinal beams, a series of diagonal truss pieces of Memel timber, 6 inches square, with their ends stepped into the cast iron boxes, which, at every 10 feet grasp the beams. On the other ends of these diagonal truss pieces, cast iron boxes were fixed, which received the straining pieces, placed 3 feet 6 inches above, and the same depth below, the roadway: an iron screw bolt, 1¼ inch diameter, at every 10 feet, and a contrivance of wedges in the cast iron boxes, enabled any degree of tension to be given to the framing.

The roadway was thus stiffened by two of the strongest kinds of framing, in parallel lines, dividing the carriage way from the foot paths; it was deemed preferable to disconnect them from the suspending rods, and, by bringing them nearer together, to avoid a twisting or unequal strain. The whole formed a compact mass of braced wood work, the diagonal plank giving the horizontal stiffness, and the two trussed frames insuring the vertical rigidity.

The weight of the new roadway was:—

	Tons.	Cwt.
Wood work,	130	19
Cast and wrought iron about ditto,	36	6
Wrought iron in the suspending rods,	20	14
Ditto in the fencing,	8	18
Gravel concrete,	30	0
Total,	226	17

Or 47.5 lb. per square foot, superficial, for the entire roadway.

The weight of the original roadway was:—

	Tons.	Cwt.
Wood work, - - - - - - -	69	0
Cast iron about ditto, - - - - -	92	0
Wrought iron in the suspending rod, - -	12	9
Gravel concrete, - - - - - -	30	0
Total, - - - - - - -	203	9

Or 23 tons less than the new roadway.

Cost.—The platform described is 412 feet long, and 27 feet wide; it cost £4,026 or about 7*s.* 3*d.* per superficial foot.

The works were completed in the summer of 1840; the bridge has borne without injury the gales of the last winter; and the stiffness of the platforms has given confidence in its strength to all who have examined it.

Five elaborate drawings of the bridge, giving all the details of its construction on a large scale, accompanied this communication; they were presented by Mr. Page on his election as an associate of the institution.

Mr. Seaward agreed with Mr. Rendel in the advantage of reducing the number of suspension chains, and thus rendering the whole construction as simple as possible. The trussed framing, which appeared to be the main feature of this bridge, was particularly deserving of commendation, as it imparted a degree of stiffness to the platform which had not hitherto been attained in other cases, although it was demonstrated to be the best method of preventing the undulation which was so prejudicial to the suspension bridges.

Mr. Rendel had, on a previous occasion, explained his view of the action of wind upon the platforms of suspension bridges, and of the necessity of a certain degree of stiffness in the construction; this he conceived would always be better attained by having a simple well trussed framing to prevent undulation, than by the application of braces or stays to check either undulation or oscillation—the latter being in his opinion only the result of the former.

He would now only insist more forcibly upon those points. The roadway should be so stiff as to prevent as much as possible all tendency to motion, because it added to the natural decay of every part of the structures; for instance, he found on taking down the chain of the Montrose bridge, after seven or eight years' wear, that the pins of the links were cut some depth into; demonstrating how great had been the amount of motion among the links. In constructing suspension chains, after this experience, he should be inclined to abandon the circular form for the pins, and forge them of a long oval shape in their transverse section; making the apertures in the links by drilling two holes, and cutting out the metal between them with a machine; this form of pin would allow sufficient play for the necessary curve of the chain, while the pin itself would be stronger,—would weaken the link less than the large circular hole, and would be less expensive to manufacture. He disapproved of all the complicated contrivances for allowing expansion of the main chains; he had found that plain saddles of proper form were quite sufficient to permit the expansion of the back chains, which was all that required attention.

Mr. Palmer mentioned, on the authority of Mr. Chapman, the destruction of a suspension bridge in America, caused by the sudden passing of a drove of cattle when frightened. This was peculiar, as it always had been considered that an irregular motion was innocuous, but that when any regular impulses were communicated, there was danger of fracture of the bars.

Mr. Vignoles eulogized this excellent communication for the practical conclusions which it contained. Mr. Rendel had materially assisted in affording facility of communication by the introduction of the floating bridges, in communication with railways, and it was not difficult to foresee that, by carrying out the system of adapting well trussed framings to the platforms of suspension bridges, sufficient rigidity would be obtained for locomotive engines and carriages on railways, to traverse rivers or ravines by means of these bridges, instead of by costly viaducts or heavy embankments.

Mr. Rendel saw no difficulty in giving any required amount of rigidity to the platforms; it was only necessary to increase the strength of the framing, to enable the roadway to bear with perfect safety the passage of an engine and a train of carriages.

The President directed the attention of the members to what he considered the most valuable part of this interesting communication—the detection of the errors in the original construction of the bridge. This was the most useful class of papers which members could present to the institution, and they were particularly valuable when they were illustrated by such complete drawings as those now communicated by Mr. Page on his election. He hoped this example would be extensively followed. He mentioned that an attempt had been made to carry a railway across the Tees by a suspension bridge, but it had been abandoned.

Mr. Rendel understood that the weight of the trains had so stretched the chains, or rather forced the moorings of the back chains of the bridge over the Tees, that the platform sunk in the centre so as to prevent the passage of the carriages; piles had therefore been driven beneath each bearer of the roadway, and the chains now remained merely to show that it had formerly been a suspension bridge.

"*Supplementary account of the use of auxiliary steam power, on board the 'Earl of Hardwicke' and the 'Vernon' Indiaman.*" *By* Samuel Seaward, *M. Inst. C. E.*

The advantage of the employment of auxiliary steam power, on board large sailing ships, had been shown by the author in a former paper (page 63); it was now further exemplified by the result of the recent voyages of the "Earl of Hardwicke" and the "Vernon."

Earl of Hardwicke.—This vessel, of 1,000 tons burden, with one engine of 30 horse power, effected the voyage from Portsmouth to Calcutta in 110 days, a much longer time than usual; but still with an advantage of 29 days over the "Scotia," a fine vessel of 800 tons, which sailed one week before the "Hardwicke," and arrived 22 days after her. During the voyage, the "Hardwicke" used her engine 364 hours, and was propelled by it 946 knots; an average of nearly 3 knots per hour; while in a calm, with the ship steady, she made 5 knots per hour. The total consumption of fuel was 90 tons.

The "*Vernon*," which sailed one month after the "Hardwicke," made her passage to Calcutta in 97 days; passed the "Scotia," and arrived 7 days before her, gaining 42 days upon her during the voyage. The "Vernon's" consumption of fuel was also 90 tons, but the copy of her log not being arrived, the number of hours during which steam was used, could not be ascertained.

The "*India*" steam ship, of 800 tons burden, with engines of 300 horse power, had not arrived at Calcutta, although she had been out 109 days, so that the "Vernon," with only auxiliary steam power, had already gained 12 days upon her.

The comparison between the advantages of these two vessels, in point of expense, is then fully entered into, and shows a saving of £3,733 in favor of the "Vernon," on a single voyage, while she gained at least 12 days upon the "India," in point of time.

This communication is accompanied by a copy of the log of the "Earl of Hardwicke," and by letters from the captains of that ship and the "Vernon," speaking in the highest terms of the assistance of the steam power in certain parts of the voyage.

"*Description of an improved levelling staff, and a modification of the common level.*" *By* Thomas Stevenson.

In enumerating the advantages of this improvement, the author passes in review the different levelling instruments in general use. He describes the self-reading staff as very useful, but ill adapted to the extreme accuracy generally necessary in the operation of levelling. He considers the running level to be equally inadequate, from the difficulty of attaining a precise coincidence in the cross wires and the vane line.

On the authority of Mr. Simms, in his Treatise on Mathematical Instruments, he states that these evils are in some measure remedied by Mr. Gravatts's rod, but he still considers that instrument to be imperfect. He therefore caused a rod to be constructed by Mr. Adie, of Edinburgh, the vane of which is adjusted by tangent screws. The range of this staff is 12·7 feet, and the graduation so perfect as to be read by verniers to the $\frac{1}{1000}$th of a foot. On the right of the lower portion of the rod there is a screw, which, on being tightened, clamps the vane, and on the opposite side is the tangent screw for adjusting it. Supposing in practice that the level line strikes the lower half of the rod, the vane and screw are then easily moved by the hand to within $\frac{1}{4}$ inch of the point, and then, by means of the tangent screw, perfect correctness can be attained.

After having sent his communication to the institution, the author learnt from the secretary, that adjusting screws had already been used in two other levelling staves by Captain Lloyd and by Mr. Bunt. He was not, however, aware of this circumstance, and he considers that these instruments being adapted only for scientific purposes, are hardly suitable for the ordinary use of the engineer.

Improved level.—The author also introduced a ball and socket joint at the junction of the legs of the common level, retaining at the same time the parallel screw plates, and adding beneath a small sluggish spherical level. By these means the surveyor is enabled to station the instrument, regardless either of the inequalities of the ground, or of the inclination of the telescope to the horrizon.

When in use, the clamp of the ball and socket is released, and the head of the level moved until the bubble shall be in the middle of the circle; the socket screw is then clamped, and the telescope brought to the absolute level by means of the parallel screws. It becomes thus unnecessary to move the legs of the instrument when once fixed.—*Civil Engineer and Architect's Journal.*

CAST IRON LIGHT-HOUSE, IN PROGRESS AT MORANT POINT, JAMAICA.
By ALEXANDER GORDON, *Engineer to the Commissioners.*

In writing a description of a cast iron light-house tower, just completed for the island of Jamaica. an opportunity is afforded for a few words on the advantages offered by this peculiar mode of construction. Mariners have frequently been deprived of the security afforded by light-houses on dangerous coasts, from the great costliness of such structures, as well as from the danger or difficulty attending their erection, in consequence of local peculiarities arising either from tidal restrictions, or from the difficulty of obtaining foundations of sufficient solidity to support the heavy mass of masonry of the tower. It is a fact, of common occurrence, that years are required to erect a light-house of very moderate dimensions where the rate of working is limited, both by the nature of the tides, and by the peculiarity of the season; and the authorities who preside over these matters, are frequently deterred from entertaining the application, for such facilities to navigation, from the cost and trouble attending their execution.

Mr. Alexander Gordon, the engineer to the commissioners appointed to carry the plan into effect, is the designer of this building, and who recommended the adoption of cast iron, in consequence of the suggestions some years ago of Captain Sir Samuel Browne, and the subsequent erection of a small light tower on Gravesend pier, by Mr. Clarke.

The advantages which iron, when not in contact with sea water, possesses over stone or other materials, is, that upon a given base, a much larger internal capacity for dwellings and stories can be obtained with equal stability. The nature of the material, admitting of the plates being cast in large surfaces, there are fewer joints, and consequently greater solidity. A system of bonding the plates may also be adopted, which will insure the perfect combination of every part, so as to form one entire mass, and by the facility which such a plan offers for uniting the parts, the best form for strength and stability can be obtained. The time required for the construction of such a building in iron being less than that required for the preparation of one of stone, would in many instances influence its adoption, and from the comparatively small bulk and weight of the component parts of the structure, much greater facilities are afforded for transporting and erecting it at its destination. It is a fact, worthy of remark, that in less than three months from the date of the contract, the light-house in question was cast and erected on the contractor's premises, and it is the intention of Mr. Gordon, the engineer, to have the light exhibited in Jamaica, on January 1st, 1842, being six months from the date of its commencement. This is a degree of expedition commensurate with the extraordinary despatch of the present day, when all operations, however great and difficult, seem to advance with a celerity which a few years back would have been deemed chimerical.

The expenses of the construction, the transmission to its destination, and its final erection, will not exceed one third the cost of a stone building of equal dimensions and capabilities, and in localities where the materials are not naturally produced, but have to be transported from a distance in a fit state of immediate erection, the expense would considerably exceed this ratio. Another prominent feature in the construction of iron light-houses, etc., is the security from electric influence, the material itself being one of the best conductors of the electric fluid, and if proper means be taken to transfer the electric fluid from the base of the tower to the sea, by means of copper conductors, no danger need be apprehended from its effects.

The light-house in question, is the first of its kind that has been practically carried out, and from its having to withstand the destructive hurricanes, which, as well as the frequent earthquakes that occur in the West Indies, it will afford a good example for future practice. The form has been selected as well for strength as for symmetry; and the arrangement of the lantern and light apparatus reflects the greatest credit on the manufacturer, Mr. Deville.

The tower is to be founded on a coral rock, a little above the level of the sea, the face of which rock is about 10 feet beneath the surface of the sand, and which will be excavated to receive the base of the tower, resting on and cased with granite, to prevent the natural filtration of the sea water from acting upon the iron. The course of granite upon which the base of the tower rests, is grooved to receive the flange of the lower plates, from which the lightning conductors are continued to the sea. The diameter of the tower shaft is 18 feet 6 inches at its base, diminishing to 11 feet under the cap; it is formed of 9 tiers of plates, each 10 feet in height, varying from 1 to ¾ inch thickness. The circumference is formed of 11 plates at the base and 9 at the top; they are cast with a flange all round the inner edges, and when put together these flanges form the joints which are fastened together with nut and screw bolts, and caulked with iron cement. The cap consists of 10 radiating plates which form the floor of the light room, and secured to the tower upon 20 pierced brackets, being finished by a light iron railing. The lower portion, namely 27 feet, is filled up with masonry and concrete, weighing about 300 tons, and so connected with the rock itself that it forms a solid core of resistance; the remaining portion of the building is divided into rooms which are to be appropriated as store rooms and berths for the attendants in the light-house.

The light room consists of cast iron plates 5 feet high, on which are fixed the metal sash bars for receiving the plate glass, these terminating in a point are covered with a copper roof, from which rises a short lightning rod, treble gilt at the point, to attract the electric current.

The light is of the revolving kind, consisting of 15 Argand lamps and reflectors, 5 in each side, of an equilateral triangle, and so placed as to constitute a continuous light, but with periodical flashes.

In order to preserve as low a temperature as the nature of the circumstances and climate will permit, the iron shell is to be lined with a non-conducting material, such as slate or wood, leaving an annular interstice, through which a constant ventilation will be effected, and by which the excessive heat will be carried off, or which it will doubtless be assisted by the evaporation of the sea spray which may be accidently cast upon it, as it will be placed within 60 yards of the ordinary water level.

In order to preserve the two lower tiers from oxidation, they have been coated with coal tar, and Mr. Gordon intends to set them in the granite with a bituminous cement. The only bracing which has been thought requisite, is a few cross ties at each horizontal joint, over which the iron tongued wood floors are laid.

The several rooms are provided with five apertures fitted with oak sashes glazed with plate glass; the approach to the doorway, which is about 10 feet above the level of the sand, will be by means of stone steps, ladder irons are also provided in the event of the stone steps being carried away by a hurricane.

Over the entrance is a large tablet of iron, supported by two small ones, and on them, in bas relief, are the following inscriptions:—

"Erected A. D. 1842,
"Under the act 3 Victoria, cap. 66.
"Commissioners.

"Vice-Admiral Sir Charles Adam, K. C. B.,	"E. Jordan, Esq.,
"Commodore Douglass, R. N.,	"P. Lawrence, Esq.,
"Hon. S. J. Dallas,	"Hon. T. M'Cormack,
"W. Hyslop, Esq.,	"Hon. E. Panton, Speaker,
"J. Taylor, Esq.,	"A. Barclay, Esq.,
"Hon. H. Mitchell,	"H. Leslie, Esq.,
	"G. Wright, Esq.,

"On the designs and specification of Alexander Gordon, Civil Engineer, London."

And on the side supporters:—

"Capt. St. John, R. A., Island Engineer.	"C. Robinson, Engineer, London, *fecit.*"

The whole of the castings were executed by Mr. Robinson at his manufactory, (late Bramah and Robinson) at Pimlico, and put together in the yard of the manufactory prior to their removal for its intended destination,

The work will be re-erected in Jamaica by means of a derrick and crab from the inside, without the aid of any external scaffolding.

ARCH. R. RENTON.

September 22, 1841.

[We understand that the whole expense of the light-house, including the passage over the Atlantic, and the erecting it on the promontory in Jamaica, will not exceed £7,000, and that the entire weight of iron of the whole fabric is about 100 tons. The masonry is being prepared in this country, as it will be more economical to send it from England than it will be to get the stone and work it in Jamaica. Three mechanics are also to be sent out with the work to put it together on its destined spot.—EDITOR.]

Civil Engineer and Architect's Journal.

STIRLING'S AIR ENGINE.

Messrs. Stirling have constructed an air-engine, now working at the Dundee foundry, which fully realizes the expectations of the inventors; its superiority over the steam engine consists in an immense saving of fuel, and in its capability of being contained in a very small space For the purpose of navigation these properties are invaluable. We subjoin a description of the air-engine, furnished us by a friend well acquainted with mechanics.

The air-engine now working at the Dundee foundry, for which a patent was lately taken out, is the joint invention of the Reverend Dr. Stirling, of Galston, and of his brother, Mr. Stirling, engineer, Dundee.

The principle of the invention consists in alternately heating and cooling two bodies of air confined in two separate vessels, which are arranged so that, by the stroke of two plungers worked by the engine, while the whole of the air contained in one of the vessels is at the lower end immediately over the furnace, and is consequently quite hot; the whole of the air contained in the other vessel is at that time disposed at the upper end, which is cut off from any communication with the furnace, and is therefore comparatively cold.

The expansion caused by the heat renders the air in the one vessel much more elastic than that in the other; and the two ends of the working cylinder, which is fitted with a piston similar to that of a steam-engine, being respectively connected with the two air-vessels; a preponderating pressure is produced on one side of the piston, and it is thereby pushed to the opposite end of the cylinder. By the alternate action of the plungers in the two air-vessels, this end of the cylinder then comes in its turn to be subjected to the pressure, and the piston is thereby pushed back again to its former position, and so it continues a reciprocating motion, and is applied to turn a crank in the same way that a steam engine does.

It has been satisfactorily shown that this engine may be worked with very great economy of fuel as compared with a steam engine; and the principal means of producing the saving is this: that, of the heat which is communicated to the air from the furnaces, only a very small portion is entirely thrown away when the air comes again to be cooled; for, by making the air, in its way from the hot to the cold end of the air-vessel, to pass through a chamber divided into a number of small apertures or passages, the great extent of surface with which it is thereby brought in contact, extracts in the first place, but only temporarily, the greater part of the heat from the air; and afterwards restores it to the air on its passage back again from the cold to the hot end of the vessel. The process of cooling is finally completed by making the air to pass through between a number of tubes in which there is a current of cold water, and thus far the heat cannot be made available again, but the portion which is abstracted in this way is very small.

As a sufficient expansive power could not be attained from using air of the common density of the atmosphere, without either making the diameter of the cylinder, and all the other parts of the engine inordinately large, or subjecting the air to greater alterations of heat and cold than would be convenient, the air is used pretty highly compressed, and a much greater power is thereby obtained upon a given area of the piston.

It is necessary, therefore, to employ a small air-pump to keep up the air to the requisite density; but very little power is expended on this; for, as the same body of air is used over and over again, all that is required of the air-pump, after the engine has been once charged, is to supply any loss that may arise from leakage; and this is found to be very trifling.

The machine has been working occasionally for about six months, and it has been proved, to the satisfaction of the inventors, to be capable of perfoming advantageously the amount of work which they had reckoned on, from their calculations, and from former experiments made on a working model of about two horses power. It has now, for upwards of a month, been doing work in driving all the machinery employed at the extensive engineering works of the Dundee foundry, which a steam engine of approved construction had hitherto been employed to do; and it has been ascertained that the expenditure of fuel is, *ceteris paribus*, only about one-fifth part of what was required for the steam engine; but, as considerable improvements are contemplated in some of the details, it is confidently expected that a much greater saving of fuel eventually will be effected.

The whole machine, including its furnaces and heating apparatus, stands in about the same space that a steam engine of equal power would occupy without its furnaces and boiler; and, taking into account this saving of space, along with the vast saving of fuel, the invention must necessarily be of immense imporance for all ordinary purposes requiring motive power; and, as an instance, it would reduce the expenses of the power employed in driving machinery in Dundee alone by at least £25,000 or £30,000 a year;

but viewed in reference to the purposes of navigation, the application of this invention must lead to results still more extraordinary, and will render a voyage to India round the Cape by machinery, a matter of perfectly easy accomplishment.—*Dundee Advertiser.*

THE ZINCING PROCESS.

We derive from the *Revue Generale de l'Architecture* the materials for the following notes on the process of zincing iron, is described by the Baron Menu de Mesnil, in the report of the committee of inquiry to the Minister of Marine in France. On the importance of preserving iron from oxidation it is unnecessary to make any remark, we may just observe that the only effective modes hitherto used have been tinning and glazing. In 1742, M. Maloin presented to the Royal Academy of Sciences a memoir on the analogy which he had observed between iron and tin, and points out a mode of zincing iron similar to the modern one. Whether the price of zinc was then too high or other difficulties stood in the way, it was not until 1836, that the process of zinking was made effective by M. Sorel, who took out a patent for it under the name of galvanization of iron. On the 28th September, 1838, a committee was named by the Minister of Marine to make experiments in the dockyard at Brest on zincing iron, by them a first report was made recommending experiments to be made on a larger scale; which latter commenced on the 14th of May, 1840, and it was on the 30th of April, of the past year, that they made their report.

The process consists simply in dipping an iron article, previously cleaned with acid, for three or four minutes into zinc infusion, then taking it out progressively, shaking it in the air to get rid of the excess of zinc, and at last plunging it suddenly in cold water; after which it only requires to be rubbed over with fine sand and dried. What is called galvanization is therefore nothing more than a process similar to tinning; but while iron is rendered more oxidable by contact with tin, and oxidizes rapidly, if by any mistake in the preparation the iron is left uncovered in any point; in zincing, on the contrary, a true alloy of zinc is formed on the surface of the iron, and the parts accidentally left unzinced alone rust, and the evil is soon stopped. This latter fact is enough to prove that the iron is not protected by any galvanic effect, as is the opinion generally received. Thus in the operations preparatory to zincing, such as cleaning by acid, etc., great care is taken to free the surface of the iron by scraping from it all matters which would resist the action of the acid, and prevent zinc from attaching to the iron all over.

The cleaning with acid is an operation which requires much care, for while it is indispensable that the iron subjected to the acid should be wholly free from rust, care must also be had that the iron be not too strongly acted upon by the acid, but be taken out at the proper moment. Very weak acids only are used for the cleaning as a mixture of nine parts of sulphuric acid with one hundred of water. In France, the refuse acid used in purifying vegetable oils is also employed; after a certain time the acid can no longer be used, as it is almost wholly turned into sulphate of iron, a salt which may be readily extracted, and which would bring more than the worth of the acid used. The time during which the iron is kept in the acid varies, according to the degree of rust, from twelve to twenty-four hours.

The pieces, after coming out of the acid bath, are cleaned and passed rapidly into hydrochloric acid of 15°, and then put in a stove to be quite dried. It is in this state of absolute dryness, that they may be plunged into the zinc infusion. At the time of immersion, the object is powdered over with sal-ammoniac, a great part of which volatilizes, and then decomposes, and the remainder, the acting portion, cleanses the object a third time, and makes the zincing certain and perfect. The use of this salt, on account of its value and the large quantity used, forms a great part of the cost of zincing. The zinc bath soon becomes covered with a black fluid matter, without adherence to the surface of the bath, on which it forms a continuous layer. The workmen consider it as advantageous to the zincing, and therefore take it out of the bath after the day's work, and put it in again the next morning, when they go back to work. During the night, the zinc it kept in fusion, and the surface exposed to the air, is tarnished and oxidized, and it may be, therefore, allowed that the black matter acts so as to dissolve the oxide formed, and thus to restore the surface of the zinc to the purity requisite for zincing properly. An analysis of this black matter, made at Brest, by M. Langonne, first class naval apothecary and member of the committee, shows it to be composed of a great quantity of chlorure of zinc, a small portion of chlorure of iron, and an insoluble compound of ammoniac and zinc. As we know, therefore, that chlorure of zinc and ammoniac are good detersives, it is not suprising that the black matter, having an analogous composition, should be equally efficacious. The time that objects remain in the zinc bath depends on the dimension, if they are thin, they must be only rapidly passed through, if massive, they must be left some minutes. In general, it is enough to take the objects out as soon as they leave off giving out smoke or rather steam.

The immersion of the zinced object, still quite hot, in cold water, is for the purpose of preventing the formation of oxide of zinc, which tarnishes the surface, but this operation gives the iron a kind of tempering, which added to the effect of a layer of alloy covering the surface, renders it more brittle. Sheet iron in particular, on account of its thinness, is subject to this inconvenience, and can no longer be bent with ease. An improvement has, however, been recently made, which avoids the dipping, the slight layer of oxide of zinc which is formed on the surface, and which does not stick, is easily got rid off by rubbing, after the object has been cooled in sawdust and sand.

When objects have just been zinced, they have a metallic lustre, which they will keep for a long time, when free from damp, but when left in the air they by little and little tarnish, become covered with a whitish efflorescence, which increases, acquires consistency, sticks to the metal, and soon forms a continuous and solid layer, which preserves the surface from ulterior alteration. This transformation is slow in taking effect, and appears to be complete only after fifteen or eighteen months's exposure to the air. Even the weakest acids and the alkalis attack and desolve the zinc with the greatest facility and bare the iron. Heated red for several minutes the layer of zinc in access soon peels off, but the iron is not yet bared, as the alloy of zinc and iron, more adherent, harder and less fusible, long repel the action of heat.

The thickness of the zinc layer is very small; on common balls it was only sixteen-hundredths of a millimeter, on sheet iron it was from seven to twelve-thousandths of a millimeter, nine-thousandths is the mean. The thickness has little effect on the windage of cannon balls, but the committee suggest that zincing might be employed to increase the diameter of deficient balls. The committee farther suggested that experiments should be made to zinc old iron objects in order to preserve them. The thickness of the layer of zinc, although so very small, is amply sufficient, when we consider that an alloy is formed with the iron, which extends its protective influence deeper into the metal.

The influence of the air or water is very little on the zinced iron, if entirely exposed, but if subjected to the action of water and air alternately, they are more affected. Zinced apparatus produces no injurious effect upon drinkable water.

As to the various articles on which they experimented, the committee report that the zincing appears very effective for roofs and cisterns. Zinced nails and bolts are recommended for shipping, but the committee are not yet prepared to recommend them to supersede copper. These nails are recommended for the decks of ships, as the ordinary nails soon produce a black spot on the surface of the wood, which penetrates and affects the fibres, gallate of iron being produced. Zinced nails are strongly urged as substitutes for iron in securing slates on roofs, as the iron nails soon rust, particularly near the sea, and in high winds are the chief cause of the slates falling. The zinced gutters the committee consider will supersede tin. For the flues of stoves, the zinced iron is recommended, and zinced wire also meets with their approbation. They had not made sufficient experiments as to chains, but they reported that those which they had tried, when put to the hydraulic test, supported it well. For locks and bolts in lighthouses and sea buildings, zincing is exclusively advocated. An advantage which zinc possesses for ear-rings for sails is, that it does not rust the sails, which is apt to rot them.

The committee conclude by making several recommendations. They reported that zincing of wrought and cast iron can easily be practised in all ordinary circumstances of the use of that metal,—that zincing shows every symptom of durability, and that it is of the greatest advantage to the navy. They consequently recommend a contract to be made with the patentee for the use of zinc in the arsenals of France, being convinced of its efficacy.—*Civil Engineer and Architect's Journal.*

Railways and Steam Power 3,600 years ago.—The lost Arts of the Ancient Egyptians.—If the Thebans 1,800 years before Christ, knew less in some departments of useful knowledge than ourselves, they also in others knew more. They possessed the art of tempering copper tools so as to cut the hardest granite with the most minute and brilliant precision. This art we have lost. Again, what mechanical means had they to raise and fix the enormous imposts on the lintels of their temples at Karnac? Architects now confess that they could not raise them by the usual mechanical powers. Those means must, therefore, be put to the account of the "lost arts." That they were familiar with the principle of Artesian wells has been lately proved by engineering investigations carried on while boring for water in the Great Oasis. That they were acquainted with the principle of the railroad is obvious, that is to say, they had artificial causeways, levelled, direct and grooved, (the grooves being anointed with oil) for the conveyance from great distances of enormous blocks of stone, entire stone temples and colossal statues of half the height of the monument. Remnants of iron, it is said, have lately been found in these grooves. Finally, M. Arago has argued, that they not only possessed a knowledge of steam power which they employed in the cavern mysteries of their pagan freemasonry, (the oldest in the world, of which the pyramids were the lodges.) but that the modern steam engine is derived, through Solomon de Caus, the predecessor of Worcester, from the invention of Hero, the Egyptian engineer.—*Westminister Review.*

Pleasure of Steam Travelling.—Our ancient friend, John Gilpin, in his trip to Edmonton, seems almost revived in the person of the reverend gentlemen described in the following narrative, from a Chelmsford journal:—Last week the Rev. C. B. Marriott, of Thundersley, having decided to proceed to the rustic quietude of Harlow, determined on entrusting himself on the Northern and Easten rail; accordingly he possessed himself of a snug first class seat, and was soon spinning along before the gale to his destination. "Harlow Station" at last stared him in the face, as plainly as paint and board could stare; but alas! the carriage door had become fixed by the rain; all his exertions could not get it down to enable him to serve the officers with notice of his intention to quit. All his calling out, and hammering the glass, as heavily as glass may be safely hammered, brought no one to his prison door; and as it was in vain for him to attempt to put a bit in the mouth of a steed which is fed with coke and driven with a kitchen poker, he soon found himself whirling along to the next station at Sawbridgeworth. Here he succeeded in achieving his liberty; and was consoled by the information that, on the *usual* terms, he could be conveyed back to Harlow. In due time the reverend traveller resigned himself to his fate and to the uptrain, but scarcely was he under weigh, when his fellow passengers informed him that *that* train did not stop at Harlow. This was too true; onwards went the monster with puff and snort, regardless of his wishes--all he saw of the desired haven of his hopes being the glimpse which steam, at thirty miles an hour, afforded him. Of course it was useless lingering at the next station, so onwards he flew to town, where, on a proper representation of the case to the directors, the hotel expenses of the night were paid by them; and the next morning he was again skimming the earth towards Harlow. Again the painted board announced to him his journey's end; again, too, the carriage door became obstinate in its slides, and it was not till the train was almost again in motion that the reverend gentleman was enabled to set foot upon the desired spot; even then it was not effected without some risk, as, in his haste to avoid a second trip to Sawbridgeworth, he did not perceive another leviathan, who a few yards off was hissing and boiling up the rail upon which he alighted.—*Chelmsford (English) Chronicle.*

Great Performance—New Locomotive.—A new locomotive called the "Lycoming," from the manufactory of D. H. Dotterer and Co's. works, weighing with water and fuel 10 tons, was placed on the Reading railroad, about a week ago. As a specimen of the abilities of the engine, we mention two of her trips. On the 2d inst., she brought from Pottsville to Reading 66 cars, 59 of which were loaded each with 3½ tons of coal—starting the train on a dead level and curve without slipping a wheel. On the following day, the engine drew from Reading to Philadelphia a train 890 feet long, consisting of 72 coal cars, carrying 239 tons freight—the cars weighing 134 tons—the gross weight of train being 373 tons of 2,240 lbs., not including engine and tender. The engine started this tremendous train at the different watering stations without slipping a wheel. The day was wet, and the train had to contend with a strong head wind, the effect of which (especially as some of the cars were "house cars") is well known. It is believed by competent judges, that under favorable circumstances, this engine would take over the same road a train of 90 cars, weighing with freight, 430 tons! This is the 9th engine built by D. H. Dotterer and Co., and is upon an improved plan.—*Reading (Penn.) Journal.*

Vegetable Ivory.—Were yesterday presented with a beautiful turned cane, or umbrella head, which has all the appearance, as regards whiteness, hardness and close texture, of the finest ivory. We we were much astonished when informed that it was a vegetable production, and grew upon a tree in one of the southern islands in the South Pacific ocean, procured by the French discovery ships. It is evidently of the cocoa-nut family, and we are informed by the gentleman to whom we are indebted for it, that some of the nuts from one of which, this head is made, are of a size sufficiently large to make a billiard ball. It is certainly very curious and important discovery, and will, should it be proved as durable as ivory, decrease the demand for the tooth of the elephant.—*Phil. paper.*

Atchafalaya Raft.—The Opelousas Gazette of the 29th January says: "Captain Mayo, the superintendant of the boat and hands at work in clearing out the Atchafalaya raft, informed us a few days since that the work was being efficiently executed, and the boat would not leave the raft until the work of destruction was accomplished. A mile and a quarter remains yet to be completed. Such is the effect of what is doing, that, we are told, the raft begins to give. This is a favorable state of things; and we may indulge in the hope that, ere long, our navigation will be at all time practicable.

The New Bridge.—The viewers appointed by the Court of Quarter Sessions, on the part of the county of Philadelphia, to inspect the new bridge at Fairmount, and report upon the merits of its construction, performed that duty yesterday. The result was in the highest degree satisfactory to the committee, and creditable to the builder, Mr. Ellet. Among other modes, to test the strength of the bridge, forty carts containing each two tons of stone, were at the same time placed upon it.

FROM LATE FRENCH PAPERS.

The annual increase in the number of travellers on the Rhine is a striking proof of the effect of the introduction of more rapid means of communication. In 1827 the number of passengers on the Rhine, by the Cologne steamers, was between 18,000 and 19,000, and this was thought considerable; but in 1839 the number had increased to 487,000; in 1840 to 636,000; and in 1841 it has been estimated at 750,000. In the course of the present year there will be 35 steamers on the Rhine, of which 16 belong to the Cologne company, 7 to the company of the Netherlands, 6 to the Dusseldorf company, 2 to the Rhine and Yssel company, 2 to the company, of the *Aigle*, and 2 to the Basle company.

It appears from a statement in the Brussels papers that the *material* of the different Belgian railways at this moment consists of 126 locomotives, 117 tenders, 95 diligences, 179 chars-a-banc, 235 wagons for passengers, 854 carriages for goods, and 202 wagons for material of the roads, etc.

A project has been started at Munich by M. Wiebeking, who is well known in Germany by his connexion with railroads, for convoking in the Bavarian capital a sort of Congress, or general meeting of European engineers, to communicate discoveries and discuss theories relative to railroads. If the project is carried into effect, the first meeting will be held this year.

The united councils of agriculture, manufactures, and commerce, met yesterday for the discussion of the iron question. Amongst other propositions which were brought forward, was one for permitting Belgian iron to enter France, in competition with French iron, for the construction of the great lines of railway which are projected.

The total system of railroads now propsed to be constructed in France is to extend to 400 leagues, which will require 200,000 tons of wrought iron.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 8, Vol. VIII. New Series.] APRIL 15, 1842. [Whole No. 404. Vol. XIV.

Our readers will no doubt peruse, with great satisfaction, the communications which Messrs. Williams and Stuart have kindly furnished us on the subject of *piled roads.* The economy and celerity of this mode of construction give it an important claim to the attention of engineers.

The communication of Mr. Williams gives an admirable instance of the divisions of labor well worth imitating. From both these gentlemen we shall be most happy to hear again, in accordance with their promise.

[For the American Railroad Journal and Mechanics' Magazine.]

OHIO RAILROAD OFFICE,
CLEVELAND, *March* 21, 1842.

GENTLEMEN: In compliance with a request made by you sometime since, asking for further information relative to the construction of a railroad upon piles, I send you an abstract of the progress of the work on the Ohio railroad. I do so the more readily, as I conceive this mode of building railroads far preferable to any other, particularly in this climate, and where timber is so abundant as it generally is in the Western States.

Our plan is to embrace in the first contract the clearing of the track, delivering the piles ready for driving;—the ties, wood and logs for rails;—piles, ties and wood, distributed on the line;—the logs (180) hauled into one yard for each section or mile, of a suitable size to make four rails, eight inches square and fifteen feet long. The pile machine is then put upon the track, and the driving of the piles done by contract, at eleven cents each,—the contractor finds himself and keeps the machine in repair. The saw mill is next put upon the track, and the sawing of the rails is done by contract for $225 per mile. The contractor finds himself and takes the logs from the yard as left by the first contractor and keeps his mill in repair. The rails are deposited on a car standing on the track, forward of the mill. They are then taken forward by the contractor for laying the superstructure, and put into the work as fast as they come from the mill. Care is taken to arrange the logs in stations, so that the rails at one, shall reach to the first station forward. The mill stands on wheels, and is hauled forward on the track the same as a car. A boarding house constructed also upon wheels is attached to each machine and mill, in which the hands board and lodge, giving them the pleasant consolation of being "always at home." In this arrangement the first contractor clears the track and furnishes the material. The second drives and saws off the piles. The third saws the rails. The fourth furnishes the pins and wedges. And the fifth lays the superstructure and completes the work ready for the iron. White oak timber is used for the piles, ties and rails. Piles are from eleven to twenty-two inches in diameter, and driven to a firm foundation, five feet from centre to centre longitudinally, and seven feet transversely. The following table shows the average cost of one mile of this road exclusive of grading, bridging, engineering and the natural wear of machinery:

	Average contract prices.
Clearing the track, - - - - - -	$100 00
2,112 piles, 30 cents each, - - - - -	633 60
1,056 ties, 18 cents each, - - - - -	190 08
180 logs for rails, $1 25 each, - - - -	125 00
75 cords of wood for machinery, 50 cents a cord,	37 50
4,224 pins and wedges, (red cedar) 1¼ cents each, -	52 80
Driving piles, 11 cents each, - - - -	232 32
Sawing rails, - - - - - -	225 00
Laying superstructure, - - - - -	375 90
	$1,971 30

The largest number of piles driven by one machine in one day was 500 or 75½ rods, and the greatest number driven in nine successive working days, by one machine, was 2,112 or one mile. Each machine is propelled by two engines of five horse power, and manned by eight men. Each mill is propelled by one engine of six horse power, and manned by three men. Time will not permit me to give you a further description of our work at this time, but should this be acceptable to those interested and to your readers generally, I will improve the first opportunity to give you a further detail of our operations in constructing a piled road.

Truly yours,

C. WILLIAMS,
Chief Engineer Ohio Railroad.

[For the American Railroad Journal and Mechanics' Magazine.]

ENGINEERS' OFFICE, SUSQUEHANNA DIVISION,
NEW YORK AND ERIE RAILROAD,
ELMIRA, *March*, 15, 1842.

GENTLEMEN: Having promised in my communication of the 25th of January last, to give you a further statement of our *experience* in the construction of PILED ROAD on this division, I take the liberty of sending you the following extracts from the testimony given by me upon this subject, when before the select committee of the assembly of 1841, appointed with instructions to investigate the affairs of the New York and Erie railroad company, and the conduct and management of the officers and agents thereof. (See report of committee, assembly documents, 1842, No. 50, page 203.)

By the CHAIRMAN,—

Question 23. Have you made or examined any tests, with the view of ascertaining the *comparative merits* of a railroad constructed upon *piles,* and one upon a bed of earth or stone, and if so, state the conclusions to which you have arrived, with the facts connected therewith?

Answer. I have made numerous examinations relative to the construction of railroads upon *piles,* within the last three years, and have become thoroughly convinced that the *piling* system is an important improvement in railroad construction, and especially in *northern climates,* where *severe frosts* and *deep snows,* are common in the winter months.

A road resting upon white oak piles, (from eleven to eighteen inches in diameter,) driven to a depth of *five* feet or over, and in all cases reaching a solid foundation, and sawed off two or three feet above the surface of the earth, is not liable to derangement by *frost* nor obstruction by *snow;* and combines in a greater degree than any other mode that has been adopted in this country, *cheapness* and *permanency;* the two most essential requisites in railroad construction. Piles that have stood in the most exposed situation on the Utica and Syracuse railroad for the *four* past winters, and those driven on this division during the summer and fall of 1840, in *every variety of soil*, abundantly prove the fact, that *frost* cannot displace them, if they are driven to a depth of *five* feet or over. A piled road is also free from the obstructions and dangers incident to a graded road, in consequence of the washing of the banks by floods and rains, and by *settling* when on soft bottom, thereby requiring constant annual expense to adjust the superstructure and replace the earth material. It will, I think, also lessen if not entirely prevent the frequent accidents that occur on graded railroads, arising from cattle and other animals obstructing the track when trains are passing at high rates of speed.

The permanent and uniform foundation, that a *piled road* affords during all seasons of the year, cannot, I think, be too highly appreciated ; and for road calculated to transport heavy freight, its decided superiority over the usual modes of constructing railroads in this State cannot be questioned.

From the experience afforded me during the construction of the Syracuse and Utica railroad, as well as the past two years on this division, I have no hesitation in strongly recommending the adoption of a *piled* road wherever the nature of the soil, surface of the country, and a supply of suitable timber will admit of such a structure. On this division there is being made over *one hundred miles* of *piled* road, along the valley of the Susquehanna, Chemung, Tioga and Canisteo rivers, of which distance, the piles are now driven for *seventy* miles, and the eight steam pile drivers are now in operation, driving the residue at the rate of *ten* miles per month.

The actual cost of this piling, (when sawed off in readiness to receive the superstructure,) has averaged less than *two thousand dollars per mile*, including the white oak pile timber, from eight to thirty feet in length, and from eleven to twenty inches in diameter, costing on an average about three and one-half cents per lineal foot, delivered on the line of road. These piles are driven from five to twenty feet, and where required by the loosenes or softness of the earth, double piles are driven to a depth of fifty feet or more, and sawed off from two to four feet above the embankment, or the natural surface of the ground.

To have substituted a graded road bed in place of piled road on this division, would have cost not less than *four thousand dollars per mile*, for the whole distance, without including the cost of grading necessary for the piled road, where the surface of the earth requires to be excavated or embanked for the purpose of bringing the earth grade from one to four feet from the grade line of the road. No difficulty has been experienced in driving white oak, chesnut, or Norway pine piles below the reach of *frost*, in sand, gravel, clay or alluvial soil; and whenever excavations or embankments occur exceeding *four* feet in depth or height, the cost of removing the additional quantity of earth necessary for a graded road bed, with its *side ditches, exceeds the cost of piling, including the piling timber.*

The excavations for pile road on this division are made twelve feet wide on the bottom, with side slopes of one foot vertical to one and a half feet horizontal. The piles are sawed off one foot above the bottom of the cuts, and a ditch of three feet wide and one foot deep, is made between the rows of piles to carry off the water. The earth from the excavations is carried into embankments, when the grade exceeds three feet in height from the natural surface of the ground. The embankments are made to within three feet of the tops of the piles, twelve feet wide on the top, with side slopes of one and one-half feet, to one foot.

There is no doubt but that the piles used on this division, will endure at least from ten to fifteen years, without incurring any additional expense to preserve them, other than the peeling off the bark above the ground, which is done immediately after they are driven.

The process of saturating the piles with sulphate of iron (copperas) or salt, can be applied at an inconsiderable expense. Salt was used on the Syracuse and Utica railroad, it is believed, with good effect. There can be no doubt of its utility, as an antiseptic. This company are about closing a contract with Manrow and Higginbothan, to saturate the *piles* with a solution of copperas or the sulphate of iron; and suitable machines, to be propelled by *steam*, are now being constructed at Owego.

From the experience that I have had in the construction of *piled road*, and from the examinations that I have made relative to the cost of grading and keeping in repair the ordinary graded roads of this country, I think I am within bounds, when I say, that the *interest* on the amount saved by building a *pile road*, instead of a *graded road*, for the one hundred miles on this division, together with the annual expense in keeping a graded road bed in good adjustment and repair, will *renew the piles*, should it be necessary, every *five* or *six* years, so long as suitable timber could be obtained at *twice its present cost* on this division.

If the *white oak* piles should *not* remain sound more than eight or ten years the expense of filling around them with earth, at the expiration of that time, with the use of *cars* to move the earth, would cost at least *fifty per cent. less*, than it would now cost to make the embankments to the grade line, with barrows or wagons, as most of the earth would require to be drawn from the hills for great distances, in consequence of the alluvial soil found along the bottom land of the river, not being suitable for making a road bed for graded roads. Wherever the valleys to be filled are deep, and the excavations from which the earth is to be taken to embank over them, are at any considerable distance off, the hauling of the earth is postponed until the track is laid on the piles, and then done with cars and locomotive power, at a great saving of expense.

Another consideration in favor of *piled road* is, that when the piles are partially decayed, the earth embankments can be *cheaply* brought up to grade, as has been shown, and the strength of the *pile* will, for *many* years thereafter, keep the track from settling; thus you will perceive, that the superstructure having been kept from the ground, and of course in a great measure preserved, the earth being brought to grade, as before remarked, and well rammed under the superstructure, we have a new and permanent road, much more permanent than roads where the rail is laid on a new, and of course, not thouroughly settled embankment.

The construction of pile road on this division, has, I think, enabled the company to make contracts with the land holder along the route (where such road is made) for right of way, fencing, and farm crossings, for at least *seventy-five per cent. less*, than they could have done, had a graded road been substituted in its place. This arises from the fact that while the piles remain in good preservation there will be no necessity of fencing along the railroad, excepting the nailing of a few boards upon the piles, while the farmer can cultivate all the land sold to the company, and which is from four and a half to six rods in width, (until it shall be required for a double track or graded road) except the width of *eight* feet occupied by the *piles*. The piled road also permits cattle and other animals to pass *under* the track, and thus saves the great expense usually required on graded roads, to make embankments over the road for farm crossings, on expensive bridges or culverts, to allow teams and cattle to pass under the road embankments. A large amount is also saved in the single item of *cattle guards*, necessary over graded roads, to prevent cattle from passing from private or public roads, or to the track of the railroad, and thereby obstruct the passage of trains; and which occasion a great share of the destruction of life and property on graded roads. A large amount is also saved by dispensing with the numerous small box and arch culverts, to pass the small brooks and creeks.

As I have before remarked, the great advantage of the *piling system* consist in its *cheapness* and *permanency;* and in regard to *durability,* it will be seen, that, if the perishable material of which it is constructed can be *renewed* at an expense of less than the *interest* upon the difference in the *first cost,* and necessary annual expense, (when compared with a *graded* road) it must result in an ULTIMATE SAVING OF EXPENSE.

[Here Mr. Stuart inserted extracts from a correspondence between himself and Frederick Whittlessy, Esq., secretary of the Towanda railroad company, in November, 1840, for the purpose of showing the committee his views respecting some of the *dis*advantages resulting from the modes so much in use in this country, of laying the superstructure on *graded* roads without a sufficiently firm and solid foundation to support it, and keeping it uniform or even, during all seasons of the year, but the committee deem it too long to be printed, in addition to his foregoing statement.]

In my next communication, I will send you further extracts from the same document, showing the manner of inspecting the piled road and pile timber on this division of the New York and Erie railroad.

I remain, gentlemen, yours,

Very respectfully,

C. B. STUART,

Chief Engineer Susquehanna Division.

[For the American Railroad Journal and Mechanics' Magazine.]

FAILURE OF RAILWAYS.

MESSRS. EDITORS: The unquestionable importance of obtaining clear notions of the "Causes of the Failure of many Railroads in the United States" or of drawing public attention to this subject, to the end that some remedial action may be had, will doubtless be a sufficient apology for occupying a portion of your useful pages with a very few more remarks.

Railroads are usually commercial enterprises, designed to remunerate their proprietors by suitable dividends upon the money expended in their construction; they are made for the purpose of conveying a traffic, either actually existing, or "which may reasonably be anticipated," and those who invest funds in such undertakings, expect returns upon their investments within a reasonable time.

That this expectation may be verified, is it not evident, that "the means must be proportional to the end," or the road to the anticipated business?

Capitalists engage in such affairs for their own immediate emolument, and consequently ought not to construct great roads where little ones would, for a series of years, be competent to do the business; for this would be erecting works for the sole benefit of a distant posterity, a design (however patriotic) but seldom entertained in these utilitarian days.

It seems unnecessary to multiply words in elucidation of a point so clear, that the writer has witnessed with unfeigned surprise the singular positions taken in this connection by some of your correspondents. Let us illustrate one of them by an example:

In the tenth annual report of the Winchester and Potomac railroad company, the president states that they have in use upon that road a locomotive of such vast power, that she "has never been loaded. Her energies have never yet been tested. Every blast from her boiler and *scream* from her whistle, is a challenge to the farmer, to the merchant and the miller, *to load her*."

This is a case in point;—it is a road made in the first instance upon a scale too great for the trade "which could reasonably be anticipated;"—which has not yet divided the first cent to its proprietors, and which has lately been equipped with machinery of a power far beyond the wants of the business, (if one may judge from the above statement of its president,) and yet X. will doubtless say that all this is judicious!

Now if a common carrier could haul all the freight between two villages with *a two horse team*, would it be good policy for him to put upon the same road *a huge wagon with a dozen horses*, and hire a man with stentorian lungs to ride upon its top and *scream for trade?*

Of course the answer to this question must be in the negative; and yet the employment of the extra horses, and of the stentor to invite business, would be but a necessary consequence of the doctrines advanced by your ingenious correspondent X.

Let us now consider a case, which is of frequent occurrence on public works, and which closely resembles several that have come under the immediate notice of the writer.

A contractor undertaking to build a work containing 6,000 perches of masonry,—the quarry is in an adjacent hill three miles distant,—the ground undulates, but generally declines towards the work,—and a common road is already formed from the quarry down, upon which to haul the stone in common wagons, would cost *one dollar and a half per perch.*

Now by constructing a wooden railroad, without iron,—generally following the natural surface of the ground,—and placing upon it wide trucks with cast iron wheels, at a gross expense of $2,000, he finds that the cost of transportation can be reduced to *a half dollar per perch,* and he then makes the following calculation:

Cost of transportation by *the existing common road,* 6,000 perches, at $1 50 per perch, - - - -	$9,000
Cost of transportation by *the wooden railway if made,* 6,000 perches, at 50 cents per perch, - - - -	3,000
Difference, - - - - - - -	6,000
Deduct cost of *wooden railroad, trucks, etc.,* complete, -	2,000
Profit, by constructing wooden railroad, - -	$4,000

This result of course justifies the construction of a rude and slight railroad, *duly proportioned to the expected trade,* and such an one is accordingly made in such cases (as it ought to be) conformably to the views advanced by Mr. Ellet.

But let us now see the result, which would ensue from the doctrine that every railroad should be built on the same grand plan, and equipped with monstrous locomotives, without regard to the trade "which may reasonably be anticipated."

Cost of a single track, edge railroad, including the graduation, three miles, at, say, $20,000 per mile, - -	$60,000
Locomotive engine and cars, (steam power being cheaper than horses,) say, - - - - -	10,000
	70,000
Deduct cost of transportation by the existing common road,	9,000
Loss, by building an iron edge railroad, - - -	61,000

So that by adopting and acting upon the doctrines advocated by X., the luckless contractor, instead of a profit of $4,000, which would have accrued by duly proportioning "the means to the end," would be actually *minus* some sixty thousand dollars, for the advantage of obtaining "*speed, power and security,*" which we are informed are the grand desiderata upon railroads.

The above is an extreme (though common) case,—but we ask, does it bear directly upon the question, and would not Mr. Ellet's views on the one hand, lead us to adopt the slight but cheap and *suitable* road; while those of X., upon the other, would counsel the use (in some form) of the stronger and more magnificent, but ruinously expensive and *unsuitable* one?

Z.

[For the American Railroad Journal and Mechanics' Magazine.]

PRESERVATION OF TIMBER.

Messrs. Editors: In your Journal for March 15th, an article appears, which strongly recommends the use of Earle's process for preserving timber by impregnation with the sulphates of copper and iron, and though the writer does not entertain the least doubt that the article in question was written with the best motives, it nevertheless appears to be *premature*, in the existing state of this question.

None know better than yourselves, Messrs. Editors, how injuriously the interests of some railway companies have been affected by the too hasty adoption of well meant, but injudicious recommendations, founded upon *too limited experiments.*

You need not to be informed that no adequate judgment can be framed of the merits of any process for preserving timber, by an experience (however favorable) of but *two years* in duration; for few, indeed, are the sticks of timber, admitted into public works, which in that brief space would give indications of decay.

No one could rejoice more than the writer, if it were indeed a settled point that Dr. Earle's process *is effectual*, but in the face of strong evidence to the contrary, it seems impossible to come to that conclusion.

In proof of this, the writer would ask your attention:

I. To the wooden pavement, *prepared and laid* (we believe) under Dr. Earle's personal supervision, in the city of Philadelphia, *Sixth street, south from Chesnut.* This pavement was adduced sometime ago in your Journal as evidence of the success of the process, but this also was *entirely premature*, for the fact can no longer be concealed, *that it is, at this moment, rotting in holes, just as the un-*

prepared wooden pavement did, in Chesnut street, opposite the United States bank, which the authorities of the city have lately ordered to be taken up and replaced by *cubical stone blocks,*—not, you will observe, by Earl-ized timber, as they probably would have done, had they been satisfied with the experiment in Sixth street.

II. To the record of the experiments of M. Boucherie, translated from the French, by Professor J. F. Frazer, and published in the Journal of the Franklin Institute, (at page 379, December, 1841,) which shows that when he attempted to protect from putrefaction the very alterable "pulp of the beet," which seems to be one of the strongest conceivable tests of the preservative action, exercised by substances mixed with the pulp, he found that ninety-five grammes of this pulp,—

In its natural state, moulded in nine days.

Mixed wilh one deci-gramme of corrosive sublimate, complete protection ensued.

Mixed with one gramme of pyrolignite of iron, complete protection ensued.

Mixed with one and a-half grammes of sulphate of iron, corruption was retarded but one day!

Mixed with one and a-half grammes of sulphate of copper, corruption was retarded but two days!!

Now, Messrs. Editors, with these facts before us, can it with propriety be said that *Dr. Earle's process has succeeded?* And if not, ought it to be recommended for adoption?

Z.

[For the American Railroad Journal, and Mechanics' Magazine.]

ON THE SPRING TRADE OF THE CITIES OF NEW YORK AND BOSTON WITH THE WESTERN STATES BY WAY OF THE GREAT LAKES.

By W. R. Casey, *Civil Engineer.*

The profession of the writer will readily suggest the particular view in which he proposes to consider the spring trade. He takes it for granted, that its importance is acknowledged by all, and considers it to be just as well known, that the want of an earlier communication in the spring with the western States is the only actual disadvantage under which New York labors, as a commercial city. If he is correct in this latter assumption,—that an earlier communication with the west is the grand desideratum,—the following remarks may be of interest sufficient to entitle them to a place in your Journal. For the object of this paper is to show the great advantages which the community would derive from being permitted to use railways in the transportation of western freight; and, secondly, that the legislature can, by granting this privilege, even to a very limited extent, place the spring trade on as good a footing as it ever can occupy, by any expenditure of money in the construction of any work in the State of New York.

By means of the Western railroad, Boston will participate in the advantages arising from any improvement in the communication with the west by way of *Albany*, and if the following views have any interest for the merchant of New York, who wishes not only to retain undiminished, but to extend his present sphere of action, they can scarcely be matter of indifference to the merchant of Boston, who is looking forward to the time when he shall, himself, participate in a trade created by his own industry and enterprize, and, in the prosecution of which, every right minded man in New York, as well as elsewhere, will wish him the success he so well deserves; for the writer considers it to be as undesirable as impracticable, that any one Atlantic port should draw to itself the entire trade of the west, which is quite large enough for all the cities, from Quebec to New Orleans, whose natural or artificial advantages are such as to offer the requisite inducements. It must be borne in mind, that the western trade to be discussed in the following pages, is that by way of the great lakes *only*.

The western trade, whether by way of Buffalo or Oswego, has, as yet, always gone by the eastern end of Lake Erie, which remains closed from four to ten weeks later in the spring than the western end. The harbor of Erie, Pennsylvania, the only good harbor on the lake, and the terminus of the Pennsylvania State works, is open sooner than any harbor in New York, hence, to have an earlier communication with the west it is necessary to strike Lake Erie still further to the westward. This may be done by a continuous railway from Albany to Cleveland, a distance of five hundred and twenty miles, or by a railroad across the peninsula of Upper Canada one hundred and thirty miles long, making, with the railways from Albany to Oswego, a distance of three hundred and ten miles, by that mode of conveyance, the remaining distance between New York and Lake Huron being accomplished by steamboat. The project of a continuous railway from Albany to Cleveland, is considered by the writer as scarcely worthy of notice, for, during the season of navigation, it would be comparatively useless, and at other times, the cost of transportation must be very high for this reason, as well as on account of the two hundred additional miles of railway. The other avenue to the west, that is, the contemplated "Great Western railway," from the western extremity of Ontario to the foot of Lake Huron, he regards the only work which can secure the best possible communication between the east and west. A paper on this subject appeared in the Railroad Journal April 15, 1840, and though the main object in that communication was to show the very decided superiority of this route for the "travel," it is obvious that the same road may be also used for the "trade" of the west.

There can be no doubt that, *eventually*, the best continuous route, open at all seasons of the year, will be made between the east and the west; but when we reflect that we have not yet even a cheap single track from Albany to Buffalo, that the present state of the money market forbid the idea of the rapid completion of the New York and Erie railroad, and that the prospect of a road on the southern shore of Lake Erie is too distant to have any interest at this time, we must conclude that our true *present* policy is to avail ourselves of those channels which our *present* means will enable us to prepare, which, though not the best possible, are still one step towards that goal; and especially is this course important, as well as judicious, when the comparatively small undertakings we can now execute, are such as will always form a part of the grand ultimate communication which, it is contemplated, will eventually distance all competition, but to the immediate construction of which, our present means may be inadequate, or which the present business of the country may not justify.

Difficult as it might be, at this time, to raise the two or three millions of dollars, to carry on energetically to completion the Great Western railroad, there is a still more important obstacle to be overcome,—for, suppose that railway now in operation, how are the merchants of New York and Boston to avail themselves of its incomparable advantages, when the Utica and Schenectady railroad is expressly prohibited from carrying freight? It is obvious, that if an earlier communication with the west be desirable, it *must* be accomplished by means of railways; but if the State government will not permit us to use these railways, we are, as regards the spring trade, as well off now as we ever can be; for the twenty-five per cent. diminution in cost of transportation, which *may* be effected by the enlargement, is quite insignificant, when compared with the importance of an avenue to the west, opening simultaneously with the Hudson,—the signal for the main spring trade, It has been proposed to allow the Utica and Schenectady railway to carry freight, paying canal tolls, and bills to that effect have been for the last two sessions reported and lost. The enormous debt which New York is incurring, in order that future generations in *other* States may not suffer the least imaginable or rather imaginary inconvenience from the want of the cheapest communication with the Hudson, has hitherto prevented even this pitiful boon. The capacity of the old canal, with the aid of the railways, is notoriously adequate to any business which can be expected during the next half century; but there is another consideration of great influence, second only to that arising from the immense expenditures on the canal, which must be understood by those whose interests are compromised by, and through whose exertions this stupendous monopoly must be modified,—the people of New York and New England, directly or indirectly, interested in the trade with the west. The opposition alluded to, will be found in the forwarders on the canal, and will be not only powerful, but energetic and concentrated.

The gross amount of tolls received on the Erie canal in 1840, was $1,536,600, of which sum $419,430 was from up freight or merchandize, and $58,459 from passengers, principally emigrants,—the baggage of these poor people being very ingeniously considered as "freight." Now, if an earlier communication with the west be desirable, and all our remarks are based on that assumption, the merchandize would, practically speaking, be all carried by railway, whether intended for this State or the western States, if the requisite permission were granted, and as the "rush of spring business" does not last more than four or six weeks, even now it would generally be over about the time of letting the water into the canal.

The immense benefits which would be conferred on emigrants by placing them in their new homes a month or six weeks earlier in the season, will readily suggest themselves to the intelligent reader.

Again, if the Utica and Schenectady railroad be permitted to carry freight, the immediate effect will be, that large quantities of merchandize for the western States will be carried to Oswego, and there await the opening of the Welland canal, which takes place before the opening of the Erie canal, and generally before the ice leaves the lake at Buffalo. Thus, instead of just entering the Erie canal at Albany, about the 20th of April, the merchandize purchased in New York and Boston, would be about that time entering the harbors of Cleveland, Detroit or Chicago. By this route, goods will only pay canal tolls from Albany to Oswego, three dollars seventy-six cents, instead of six dollars fifty-three cents, from Albany to Buffalo, and if the "Ericcson's propellers," or some similar improvement, which it is proposed to apply to sailing vessels on the lakes, should succeed, and the failure of all of them appears scarcely possible—the route by Oswego will be cheaper than that by Buffalo, even with the greatest anticipated reductions in the cost of transportation on the enlarged canal. The present plan is to enlarge the Erie branch of the canal one hundred and ninety-two miles to Buffalo, and to leave the Ontario branch, thirty eight miles to Oswego, in its present dimensions, which, rendering necessary a transhipment at the point of divergence, Syracuse,—will, it is hoped by the friends of the Buffalo route, completely break down all competition in the forwarding business by way of Oswego.

It only requires thirty-five miles of railway from Syracuse to Oswego to enable the merchants of New York and Boston to have their goods afloat on lake Erie, in nine years out of ten, before the opening of the canal at Albany, and generally about as early as by the New York and Erie railroad, were that route in operation, except in very early seasons, as in the year 1828, 1838 and 1842, extreme cases, when the harbor of Buffalo even, was open early enough. The Welland canal opens before the Erie canal even with its present light draught of water, because the opening of the latter is retarded by the frost in its banks in the valley of the Mohawk, but the great advantage of the route by Oswego is found in the fact, that the navigation of Ontario to Port Dalhousie, the *eastern* terminus of the Welland canal, and a little farther *west* than Buffalo, is always open early in April, generally in March; and Port Maitland, the western terminus of the Welland canal, lies on the *windward* side of the lake, and is several miles to the *westward* of Dunkirk, so that in late seasons it would offer at least as early a route to the west as the New York and Erie railroad, and at such times, when most needed, its advantages would be peculiarly felt.

It is evident therefore, that nothing short of a repeal or modification of the State monopoly of western transportation, can be of any immediate advantage to the spring trade. But even with the sorry privilege of transporting freight on railways, paying the same tolls to the government as if carried on the canal, and that too, only permitted before the opening of the navigation,—the spring trade of New York and Boston, by the great lakes, would be about as early as that of Philadelphia, by way of Erie. The mere time of the opening of any avenue to Lake Erie, is not the main consideration; the question is, by which route can we soonest be afloat on that lake? The merchandize from New York and Boston will await the opening of Lake Erie *on* the waters of Ontario, a little to the westward of Buffalo, and will only have forty miles of canal to pass through, to reach, without any transhipment, any port west of Buffalo; and allowing the Welland canal to open generally ten days before the eastern end of the Erie canal, and eight days for the trip from Albany to Buffalo, there can be little risk in anticipating a route earlier than the present one by three weeks, in ordinary seasons, four or five weeks in *late* seasons, as in 1829, 1831, 1835 and 1837, when the navigation opened at Buffalo between the second week and last week in May, and one or two weeks after the opening of the lake at Buffalo in *early* seasons.

The Western railroad of Massachusetts was projected to enable that State to come in for a share of the direct trade with the west, but, if the present government monopoly in this State be kept up, that work must be a failure, as far as the western trade is concerned, however successful it may be in deriving support from other sources. Allow the Utica and Schenectady railway to be used for the transportation of freight, and NOTHING MORE is required to give a communication generally as early as has ever been expected from any route in this State, though anything like uniformity in the opening of a route by the eastern end of Lake Erie is impossible, for that event is delayed or brought about by a gale from the west or east, and it is owing to the well known prevalence of westerly winds, that the eastern end of the lake is so often closed from one to two months later than the western end. The year 1841 offers a good illustration,—on the 13th of April, the lake at Buffalo was full of ice, a gale sprung up from the eastward, and on the 14th, the steamboat General Wayne entered the habor. Had this gale been from the westward, the lake might have been closed at Buffalo till sometime in May. Again, a gale filled the harbor of Dunkirk with ice, and it remained closed, while the navigation to Buffalo was perfectly free.

The following table from the report of the Canal Commissioners, for 1841, will prove all that has been alledged of this worst feature, —extreme uncertainty of any communication with the western States, by way of Buffalo. The year 1841 has been added to the list:

Year.	Lake open at Buffalo.	Canal open.	Canal open before lake, days.	Lake open before canal, days.
1841,	April 14,	April 24,		10
1840,	" 27,	" 20,	7	
1839,	" 11,	" 20,		9
1838,	March 31,	" 12,		12
1837,	May 16,	" 20,	26	
1836,	April 27,	" 25,	2	
1835,	May 8,	" 15,	23	
1834,	April 6,	" 17,		11
1833,	" 23,	" 19,	4	
1832,	" 27,	" 25,	2	
1831,	May 8,	" 16,	22	
1830,	" 6,	" 20,		14
1829,	" 10,	May 2,	8	
1828,	April 1,	March 27,	4	
1827,	" 21,	" 21,	31	
			129	56
			56	

Difference in favor of canal, - - 73 days.

Here we see, that in ten years out of fifteen, the lake was behind the canal, but when the lake opens before the canal, no practical advantage results, for it requires eight days from Albany to Buffalo, and if the lake be not more than eight or ten days behind the canal, there is no real hindrance on that account. Even with the permission to carry freight to Buffalo by railway, it is only in five years out of fifteen that any saving of time would have been secured. It is obvious that there is no possibility of a *uniformly earlier* communication with the west, by way of Buffalo, and the circumstance of the lake having been navigable in March, 1838 and 1842, is no sort of compensation for its having remained closed till the last week in May, 1837.

The writer has never seen any statement of the times of opening of the harbor of Dunkirk. In 1837 the difference must have been three or four weeks in favor of Dunkirk over Buffalo; in 1838 and 1839 the difference was unimportant; in 1840 the time of opening is not known, but he believes it to have been in favor of Dunkirk; and lastly, in 1841 and 1842, Buffalo had the advantage. The route by railway to Buffalo, would be, judging from the experience of the last six years, inferior to that by Dunkirk, two years; superior to it two years in six; and two years equal to it. The advantages of Dunkirk arise from its being to the westward of Buffalo, and Port Maitland has a similar advantage over Dunkirk, besides the still greater one of being on the windward side of the lake. On the other hand, Dunkirk is the terminus of a railway,—Port Maitland that of a canal; and the liability of the latter to accidents and delay from various causes, would do something toward equalizing the advantages of the two routes. But thirty-five miles of railway, in an easy country, are only required to complete the route via Oswego, and many millions to finish that via Dunkirk; besides which, the permission to use railways for the transportation of freight, will insure the immediate construction of the former. Hence the routes via Oswego and Buffalo by railway, may be rendered almost immediately available for the spring trade, and they together furnish at least as early a communication with the west, as well as a more regular one, than can be afforded by the New York and Erie railway, the only work projected in this State to aid the spring trade via the lakes. As these advantages may be obtained by a mere legislative enactment, granting to the citizens of New York, to a small extent only, a privilege enjoyed to the fullest extent by the people of every other civilized community, and without any outlay on the part of the State, the subject is well entitled to the serious consideration of merchants engaged in the western trade.

The cost of transportation on various routes will now be considered. By the "cost of transportation," is meant the sum paid by the community for the carriage of a given quantity of freight from one place to another, which is very different from the sense in which it is used by the State officers, forwarders, etc., who understand the term to imply the charges of the forwarders exclusive of the tolls to the State, a distinction which has led to very erroneous impressions. The forwarders generally agree on some uniform rates of charges each spring, but as no agreement was made for 1841, and as the business was ruinous, the average rates for the three previous years will be given.

Time from Buffalo to Albany, nine days.

		Per 100 lbs.		Per ton.		Per ton per mile.
New York to Albany by steam,	"heavy,"	10 cts.	=	\$2	=	$1\frac{1}{6}$ cts.
" " "	"light,"	20 "	=	\$4	=	$2\frac{1}{3}$ "
Albany to Buffalo by canal,	"heavy,"	85 "	=	\$17	=	$4\frac{7}{12}$ "
" " "	"light,"	110 "	=	\$22	=	$6\frac{2}{3}$ "

By railway to Buffalo.

	Per ton.
Albany to Buffalo, 320 miles, at 6 cents per ton per mile,	$19 20
Canal tolls, 363 miles, at 9 mills per 1,000 lbs. per mile,	6 53
Total cost by railway from Albany to Buffalo, - -	25 73
Highest charge on canal, - - - -	22 00
Difference in favor of canal in cost per ton, - -	$3 73
Difference against canal in time, - - -	6 days.

By railway to Oswego.

Albany to Oswego, 182 miles, at 6 cents per ton per mile,	$10 92
Canal tolls, 209 miles, at 9 mills per 1,000 lbs. - -	3 76
Oswego to Port Maitland, at 40 cents per 100 lbs. (highest rates,) - - - - - - -	8 00
Total cost from Albany to Port Maitland, a harbor to the westward of Dunkirk, - - - -	$22 68

This differs from the charges on the canal only 68 cents per ton, and, as already explained, the route by Oswego will be earlier and less variable in its time of opening.

The following is taken from a Philadelphia paper:

" *Rates of freight between Philadelphia and Reading,*—

" Plaster, slate, tiles, gypsum and bricks, $1 80 per ton of 2,240 lbs. equal to $1\frac{3}{4}$ cents per ton per mile of 2,000 lbs.

" Pig iron, blooms, timber, tar and pitch, $2 20 per ton of 2,240 lbs., equal to $2\frac{1}{20}$ cents per ton per mile of 2,000 lbs.

" Flour 25 cents per barrel, equal to $2\frac{1}{2}$ cents per ton per mile of 2,000 lbs.

" Dry goods, etc., $4,40 per ton of 2,240 lbs., equal to $4\frac{1}{10}$ cents per ton per mile of 2,000 lbs.

" No storage will be charged for receiving or delivering freight at any of the depots on the line, unless allowed to remain over ten days."

The average cost of transportation of flour from Albany to Buffalo is $79\frac{38}{100}$ cents, (Senate document, 1841, No. 51, p. 12,) or per ton per mile, $2\frac{8}{100}$ cents, which is $\frac{2}{5}$ of a cent per ton per mile less than on the Reading railroad, with only $\frac{1}{4}$ the speed and during little more than half the year, besides the canal being very nearly four times as long as the railway, an advantage nearly worth that trifling difference of $\frac{2}{5}$ of a cent per ton per mile. Taking all things into consideration, the greatest friend of the Erie canal must admit that the Reading railway offers a *cheaper* communication than that canal, notwithstanding the might of the government forces all western freight into its channel; in every other respect, its advantages over the present or enlarged canal are such as to forbid comparison.

From Boston to Albany, by railways belonging to two distinct companies,—a distance of 200 miles,—freight is carried for from \$5 50 to \$10 per ton, or from $2\frac{3}{4}$ to 5 cents per ton per mile, at 10 miles per hour, over grades of 84 feet per mile. It will be observed that 6 cents per ton per mile has been allowed on the railways from Albany to Buffalo and Oswego, which is more than twice the rates on the Reading, and 20 per cent. more than the highest rates on the Worcester and Western railroads. It is evident, from the prices, that a road, as well built and managed as these two last, in the vicinity of the Erie canal, would compete successfully with that work. But it must be remembered that the railways of New York are built in the cheapest manner, and that the proprietors look forward to large dividends on the least possible outlay, as the great object of those undertakings, while it is well understood, that the Western railway, in Massachusetts, was projected to advance the general interests of the State, and especially to open a *direct* trade with the west for the manufacturers and merchants; hence, the cost of transportation will be as low as possible,—dividends, beyond five per cent., being of little importance, compared with the indirect benefits expected from that noble work. Nothing is therefore said of the railways of this State taking the *general* trade of the canals, but it appears certain that the facilities they offer will enable them to *command* the "spring trade" and emigrants.

In the same cautious and practical spirit, the writer considers it proper to make the following remarks: A committee of the Massachusetts legislature intimated that a railway was actually better than a navigable river! and the special report of the canal board of New York, 1840, contains the following remark, which may lead the incautious reader to imagine that the cost of transportation on navigable rivers is greater than on a well constructed large canal, though in fact, the price of *towing* is alone alluded to: "The circumstance, too, can hardly fail to excite attention, that while the cost of drawing a loaded barge through that canal, 43 miles, (Delaware and Raritan,) is but \$14, the expense of towing the same barge by steam upon the navigable waters from New Brunswick to New York, a distance of 40 miles, is $25. In truth the facilities which are presented by a deep and wide canal for economical traction do not appear to be fully appreciated." The difference in velocity is not given.

With reference to the transportation of freight, it will be sufficient to state that the toll on a barrel of flour from Buffalo to Albany is 33 cents, and that a reduction of tolls in consequence of the enlargement has never been proposed, though it is hinted "that if there be any strong necessity for an increase of revenue, that the business of the canal would not be injured by an addition of 20 per cent. on the present tolls. (Senate doc. No. 51, 1841, p. 12.) The cost of transportation from Albany to New York by steam, has been for years, $12\frac{1}{2}$ cents per barrel of flour, equal to $7\frac{86}{100}$ mills per ton per mile, the minimum rates of toll fixed by the constitution being $8\frac{92}{100}$ mills per ton per mile, which is 13 per cent. more than the *entire* cost of transportation by steam on the Hudson, at the rate of six miles per hour and during nearly nine months in the year. Flour is carried for 25 cents per barrel by steam from Detroit to Buffalo, a distance of 320 miles, and numerous similar and perhaps still stronger instances may be found on the great lakes. The most effectual way to bring the cause of internal improvements into disrepute, is to overrate their advantages, and thus lead the community to expect results which can never be realized.

In speaking of the extreme uncertainty of the route by Buffalo, it is not to be inferred that the opening of the Welland canal is as uniform as can be desired, but merely that the latter route varies less than the former, is *generally* earlier, has always been cheaper, and with the "propellers" or tow-boats, will be quicker and equally regular. The season of 1841 was one of the most backward ever known, yet the ice left the lake at Buffalo much earlier than usual, owing to the prevalence of easterly winds, and could western freight have been carried on railways, merchandize would have reached its destination three weeks earlier than by the canal, and earlier than by the New York and Erie railway or the Welland canal. On the other hand, in 1837, merchandize via New York and Erie railroad or Welland canal, could have been delivered in Cleveland, Detroit, etc., four weeks before the ice left the lake at Buffalo. When the merchants of New York and Boston are *satisfied* that the Great Western railroad is the key to the spring trade and travel of the west, by way of the lakes, its rapid construction is certain; and this knowledge is sure to follow the repeal of the "imperial" monopoly, and by opening the route by Ontario, will make the public acquainted with the advantages of that lake.

There are, therefore, two great obstacles in the way of any improvement in the spring trade with the west,—the "peculiar institution" of New York prohibiting the citizens from carrying freight on those railways which lead to and from the west,—where the privilege (!) is most required,—and the excessive variations in the opening of the eastern end of Lake Erie. The removal of the former depends on the action of the legislature of this State; the latter must be effected by striking the lake to the westward of Buffalo. For about two years out of three, the route by Oswego and the Welland canal would offer decided advantages over that by railway via Buffalo; in about one year out of three, the latter would have the advantage, so that in *every* year there would be a communication with the west *earlier* than we now have, if the people were allowed to choose the mode of transportation according to their own ideas of their own interest. But by striking the western waters at Detroit, and thus avoiding the ice in Lake Erie altogether, by means of the Great Western railway, merchandize from New York and Boston may be delivered at Detroit early in April, and,—following the ice down the lake,—at Toledo, Sandusky, etc., before the ports of New York are free from ice. The following extract from the "Sketch of Civil Engineering in North America, by David Stevenson, Civil Engineer, London, 1838," presents a lively view of the insurmountable obstacles to a uniform communication with the west by way of Buffalo; and what is more important than "regularity" in great public thoroughfares?

"In 1837, the year in which I visited America, the navigation (of Lake Erie) was not wholly open till the last week in May. On the 20th of that month, I passed down Lake Erie, on my way to Buffalo, in the steamboat 'Sandusky,' on which occasion, even at that late period in summer, we encountered a large field of floating ice extending as far as the eye could reach. Our vessel entered the ice about seven o'clock in the morning, and at twelve in the forenoon, she had got nearly half way through this obstacle, when a breeze of wind sprung up, which, from its direction, had the effect of consolidating the field into a mass so compact, that our vessel being no longer able to penetrate it, was detained a prisoner, at the distance of about ten miles from Buffalo, the port for which she was bound. * * * While the shores of Lake Erie presented this sterile appearance, and were still plunged in the depths of winter, the country in the neighborhood of Quebec, although lying three degrees further north, was richly clothed with vegetation."

As yet, Lake Erie, or rather its eastern end, is the key to this trade; the departure of the ice from that water is the sole regulator of the spring trade and travel between the western and northern States, and must continue to be such until the opening of the Great Western railroad, when the cities of New York and Boston will be no longer trammelled in their movements in the spring by the late and worse than all, uncertain opening of Lake Erie, varying nearly two months in two successive years, (1837 and 1838) but will be enabled to avail themselves of the best possible route to the far west.

The above (with the exception of a few lines,) was written last year, and the present spring corroborates the views advanced. The harbor of Buffalo has opened and closed once or twice, and though the journals of that city have alluded to the miles of ice which blocked up the harbor of Dunkirk,—the navigation being open to Buffalo,—it may still turn out that the permanent opening of the lake may not differ much at those places. The harbor of Dunkirk has been newly formed, and six years experience may not be considered sufficient time to show its merits or defects, still the fact that the first boats down the lake, in two successive years, have reached Buffalo before they were able to approach Dunkirk, and the more important circumstance, that a "northwester,"—a phenomenon by no means uncommon on Lake Erie,—*must* fill the harbor, when the ice has broken up and is floating about in that part of the lake, appear to the writer to put an extinguisher on all substantial claim of superiority of Dunkirk over Buffalo, as regards the spring trade by the lakes.

The tax proposed will fortunately do away with all financial difficulties, for this, with the income of the Erie canal under any circumstances, will fully meet the expenses of the government and the interest on the debt, assuming of course that no works will be undertaken in future unless sure to clear expenses and interest at least. A vigorous move on the part of the vast number of persons directly or indirectly interested in the western trade, might procure at the next session of the legislature some modification of this "peculiar institution," though complete emancipation cannot be expected for some time, as in such an event, an enormous debt for enlarging the canal could not be shown to be "necessary," while, under existing circumstances, the boats are occasionally crowded on a few miles of the eastern division, a circumstance paraded on all occasions; the fact, that the western division is worked to about one-third of its capacity, being as carefully avoided. In short, the choice lies between an immense public debt, with the latest and slowest, or a smaller temporary debt, with the earliest and quickest communication with the west.

The writer has endeavored to lay before the reader what he considers the great obstacles to any improvement in the spring trade by way of the lakes, and in conclusion remarks, that no amelioration can be expected as long as the government prescribes the channel through which all the western trade must pass, naming also the days of opening and closing, asserting thus, by its acts, that the trading community is not the best judge of its own interests when the *western* trade is under consideration, though in other respects, it—the government—leaves the citizen at liberty to send his merchandize to any *other* part of the world in any way he pleases; also that the earliest possible construction of the best possible route or routes for the trade of the lakes, will be rendered certain if the government will only "let the people alone."

New York, *March*, 1842.

[For the American Railroad Journal and Mechanics' Magazine.]

PRESERVATION OF TIMBER.

Messrs. Editors: I had hoped to add to the following strong attestation of Mr. Archbald, the result of another fungus-pit, containing cordage, canvas and timber, but am informed by the gentleman, under whose direction it was, that, owing to some error or imperfection in the construction of the pit, it has proved unavailing of any effect on the materials subjected to it. I am compelled, therefore, to defer this to a future communication, and must be content, at present, to give the following "extract," which may add to the confidence and satisfaction of those who have already adopted the process, and remove the scruples of such as may still be doubting.

Extract of a letter from James Archbald, Esq., Chief Engineer to the Delaware and Hudson canal and railroad company, dated Carbondale, March 21, 1842:

"To your inquiries as to the long continued trial I have been making of the rope, prepared, according to your process, with the sulphates of iron and copper, since your reference to it in your circular of March, 1841, I have the gratification to state, that at the request of the president, John Wurts, Esq., of the Delaware and Hudson canal and railroad company, that piece of rope (it was such as is known as two-inch rope) was subjected, about two years ago, to the most powerful influence of heat and moisture I could produce by means of a hot-bed or fungus-pit. Along side of it was placed another piece of similar rope not so prepared, which, when I opened the pit to ascertain the result, was found entirely rotten. I then replaced it with a *second* sound piece, laying it as before, by the side of yours; and this, in due time, was found thoroughly decayed; and in the same way, a *third* piece was completely destroyed. Indeed, so severe was the test, and the preservation of the prepared rope, at the end of the experiment, was so satisfactory, that it induced me to recommend your process to the company, whose mines and railroad are under my charge, and who are in the use of large amounts both of timber and of rope for the inclined planes. I am glad to find they have adopted my advice and contracted with you; and as soon as you can send me the necessary apparatus, I shall put it in operation, for there is much to be done this season."

The destructible principle, albumen, in cordage, being identical with that of canvas and timber,—the inference from the above is too obvious and important to escape attention or experience neglect; and the practicability (now perfectly ascertained) of applying the process to the *centre* as well as the ends of the largest and longest piece of timber, and of accomplishing this in a few days; every desideratum seems supplied that can justify confidence in, and induce to the employment of, this mode of protecting vegetable matter from decomposition.

EDWARD EARLE, *Patentee.*

PHILADELPHIA, *April* 5, 1842.

[For the American Railroad Journal and Mechanics' Magazine.]

DELAWARE AND HUDSON CANAL AND COAL COMPANY.

Their report for 1841 comprises the following particulars:

Capital stock, - - - - -		$1,922,000
Loans from the State of New York, -	800,000	
" " Individuals, - - -	78,000	
		878,000
		$2,800,000

The canal is 107 miles long, 30 ton boats, and the railway is 16 miles long, worked by 5 stationary engines.

The following statement shows their coal operations for the season, 1841–'42:

March 1, 1842.			
By railroad and canal tolls, - - -		$39,400	
" Interest received, - - -		14,300	
" Profit on purchase of stock to cancel convertible bonds, - - - -		33,000	
			86,700
" Sales of coal in 1841, -	203,000 tons at $5 50		1,117,000
" Coal on hand, - -	18,300 " "		104,600
Tons,	221,300		$1,308,300

March 1, 1841.			
To coal on hand, - -	29,000 tons at $6		$174,300
March 1, 1842.			
To coal sent to market in 1842, cost, viz:			
Mining, - - - 58 Transportation on railroad, 58 Toll or repairs to canal, 58 Freight, - - - $1 37 Interest on loans, - 25 General expenses, - 24	192,300	" 3 60	693,100
Balance, profit of the season, 1841–'42, - -			440,900
Tons, - - -	221,300		$1,308,300

In 1839, the profit of the season is stated at	$117,412	and the dividend at 7 p. c.	$134,540
In 1840, " " " "	211,233	" " "	134,540
In 1841, " " " "	440,985	" " 10	192,200
	$769,630		$461,280

To surplus in cash, March 1, 1842, - - - - - -	$203,750	
" coal, " " - - - - - -	104,600	
		308,350
		$769,630

Showing a surplus clear of the dividends for 1841, of $308,350 which may be set off for bad debts, fall in price, mine rent and sinking fund for repairs, etc., etc. Up to this date, there have been taken in all from their mines 1,200,000 tons, beginning from the year 1829.

The economy in the mining and general operations of this company may be held up to imitation for other regions; and as it appears that it can deliver coal in market at about $3 50 per ton, it will be able to accommodate the consumer at about $4, and still make a fair dividend, if it can maintain its business at 200,000 tons per annum.

The report concludes, by remarking in reference to its future prospects, that,

"It is thoroughly provided in all respects for an efficient prosecution of its business; and it will be pursued, during the ensuing season, with vigor and undiminished confidence on the part of the board, in its productive character, to the stockholders.

"By order of the board.

"John Wurts, *President.*"

THE POST OFFICE IN THE OLDEN TIME.

It is somewhat of an unsettled point with historians, as to whom we are indebted for the institution of the letter post. The necessity of such an establishment in every extended government, and the obvious advantages resulting therefrom, must have caused their introduction close on the foot prints of civilization and refinement. The Post Office system as we enjoy it, however, is the result of modern knowledge and improvement; and has greatly enlarged every beneficial feature which pertain to more ancient plans. Darius, king of Persia, established a line of posts for his private use, having relays of men and horses stationed at proper points along the great roads of his kingdom, so that intelligence could be easily communicated from its extreme boundaries to the capital. The Emperor Augustus of Rome also instituted posts, after very nearly the same manner as the Persian monarch. Various improvements were however adopted by Augustus and the Emperors who succeeded him, which greatly enhanced the value of the post as an agent of government, either for the surveillance of its subject, or for the transmission of its orders.

The earliest notice of such a convenience in modern times, occurs in the thirteenth century, when the students of the University of Paris, established various, though rather uncertain lines of communication with their several familes and friends. The English Universities soon followed the example of the French students; and these seats of learning, hoary with age, and venerable with the gathered wisdom of ages, gave birth to a scheme, which binds together the most distant members of the human family in affectionate communion, and preserves from blight and anguish the hopes and hearts of generations of mankind.

In 1464, Louis XI. of France established by royal ordinance, posts for the use of the court and political purposes only. It is uncertain when posts were introduced into England. That they existed in the reign of Elizabeth, is evident, from the fact, that, in 1581, there was a chief postmaster there; and the office of "Post Master for foreign parts," was established by James I. who placed at its head Mathew de l'Equester. Charles I. was the first English monarch, who determined to annex the post office as a department of revenue to the government, and for this purpose established in 1635, under the management of Thomas Witherin, a letter "office for England and Scotland." Intestine troubles, soon ripening into civil war, prevented the advantages which would naturally have grown out of this scheme; though Cromwell took it up with great spirit, and effected some judicious measures in its management. It had hitherto been an expense to the government. The Commonwealth Parliament confided it to the care of Attorney General Prideaux, who was immediately able to save £7000 per annum. In 1649 he established a weekly post through the principal towns and cities, and so beneficial were its results, that at the time of the restoration, the revenue of the office was farmed out at over £20,000 per annum. In 1700 the income was about £100,000. One century after, it netted the government over £800,000.

It was not until 1619, that any regularly organized method was adopted for the transmission of letters in France, private couriers and governmental agents being the only letter messengers.

In 1616, Count de Taxes established posts in Germany, which proved so useful that the Emperor adopted them as part of the machinery of government, and gave the Count, as a testimony of his favor, the office of postmaster for life.

From these points, the system of posts was gradually extended over Europe. International laws and facilities followed; though even in England it was a long while before the introduction of those improvements, which the peculiar and confidential nature of such a conveyance required. Most of the present features of the English system were originated and matured since the revolution. In our next we propose to offer an account of the post office in America before the revolution.—*Savannah Georgian.*

THE POST OFFICE IN AMERICA BEFORE THE REVOLUTION.

The history of this species of colonial intercommunication is remarkably interesting, as showing the gradual increase of the settlements, the growing facilities of travel, and the strengthening of that bond of Union which a common soil and a common fatherland had begun, and which was perfected by the confederation of the Revolution. We find the first notice of a colonial post office in the General Court records in 1639, wherein the house of Richard Fairbanks was appointed as a kind of local post office for the reception of "all letters which are brought from beyond the seas or are to be sent thither," and "he is allowed for every such letter 1*d*, and must answer all miscarriages through his own neglect in this kind."

In 1677 the merchants of Boston thus petitioned "the General Court now sitting in Boston.

"*May* 23, 1677.

"We whose names are under written, hearing many complaints made by merchants and others, and several of us being sensible of the loss of letters; whereby merchants especially, with their friends and employers in foreign parts are greatly damnified; many times the letters imposted and thrown upon the Exchange so that who will may take them up; no person without some satisfaction being willing to trouble their houses therewith; so that letters of great moment are frequently lost:—our humble petition therefore to this Honored Court is, that they will please to depute some meet person to take in and convey letters according to direction; and the Honored Court set the prices on letters and state that affair. And if this Honored Court please, we suppose Lt. Richard Way may be a fit person for that service."

This was signed by William Brattle, John Pynchon, Jr. and fifteen others. It was acceded to, with the exception of appointing Mr. John Hayward "the scrivener" instead of Richard Way.

In 1683, William Penn, the proprietor of Pennsylvania, established posts within the circuit of most of the Pennsylvania and Maryland settlements.

On the 17th February, 1691, Thomas Neale, Esq. was, by letters patent under the seal of England, appointed Postmaster General of of the American colonies with "full power and authority to erect, settle and establish within the chief ports of their majesties' colonies and plantations in America, an office or offices for the receiving and dispatching letters and pacquets; and to receive and deliver the same under such rates and sums of money as the planters shall agree to give, and to hold and enjoy the same for the term of twenty-one years."

Under this patent, Col. Andrew Hamilton of New York, acted as Deputy Postmaster General.

In 1692, the assembly of Virginia, under Sir Edmond Andross, confirmed the patent, but the difficulties of travel and the sparseness of the population prevented its provisions from being carried into operation.

The Assembly of New York settled on Col. Hamilton a salary of £50 per annum for three years; the Legislature of Massachusetts, allowed Duncan Campbell, the postmaster of Boston, £25 per annum for two years; and the Court of Hampshire, (New) £20 for three years.

In 1700, the Assembly of Pennsylvania erected a post office at Philadelphia.

It seems, however, by a petition of John Campbell, "master of the post office of Boston and New England," in 1703, that Col. Hamilton, the lessee of the patent of Neale, had lost over £1,400 sterling in settling the Post Office system, was refused reimbursement by Thomas Neale, and thereupon mortgaged the said patent, so that it ultimately devolved on Col. Hamilton, his heirs, etc.

Savannah Georgian.

Western Railroad.—The Erie canal will be opened on the 20th inst. Before that time, the summer rate of through-freight, on the Western railroad, will be fully established. This summer-rate is so calculated as to compete successfully with the ocean communication between Albany and Boston; in other words, it will be cheaper to send goods generally by the Western and Worcester railroad, between Albany and Boston, than to send them by the way of the Atlantic Ocean and North river. Flour, for instance, will, by the large quantity, be taken at 32 cents per barrell, which (taking into view the saving of insurance, wharfage, interests, delay and uncertainty of sea passage, etc.) is cheaper than 28 cents the usual freight by sea between Albany and Boston. Articles of greater value will be charged a higher freight; because there is a greater saving in the insurance and interest. Way-freight will be charged higher in proportion to distance; but, in no case, higher than for a greater distance. In fact, the tariff is calculated to secure the business, with rates profitable for the railroad, on an average.

The inquiry then is: "Will there be any business?"

Let the official account of the actual freight, on the Erie canal, in 1841, answer the inquiry. This official account is derived, from the report of the Canal Commissioners, to the legislature of New York, for 1842, Senate document, No. 33, table A. This table is as follows:

Description, quantity and value of all the property cleared at the collector's office on the New York State canals, in 1841.

Fur and peltry, pounds,	6,068,000	$7,463,356
Boards, ashes, timber, staves, etc.,	642,500	4,377,747
Pork, barrels,	143,800	1,423,117
Beef, barrels,	21,153	154,755
Cheese, pounds,	15,458,000	924,266
Butter and lard, pounds,	16,660,000	1,982,872
Wool, pounds,	4,490,000	1,659,511
Flour, barrels,	1,911,768	10,478,416
Wheat, bushels,	3,083,700	3,373,451
Rye, corn, barley, bran, etc., tons,	43,700	835,878
Cotton, tobacco, clover, grass, flaxseed and hops, tons,	6,012	1,069,447
Leather, furniture, pig iron, etc., tons,	127,896	5,422,615
Merchandize, pounds,	282,108,000	50,134,320
Stone, lime, clay, coal, gypsum, etc., tons,	215,528	2,903,178
Grand total, tons,	1,521,661	$92,202,929

Mark ye, gentle reader, the grand total is upwards of ninety-two millions of dollars! equal to the whole amount imported in American vessels, in the whole United States for the year ending 30th September, 1840, as per Treasury tables.

And the above tonnage, 1,521,661 tons, on said canals, is about equal to the number of tons of American shipping entered in the whole United States from foreign ports, during the year ending 30th September, 1840, which was 1,576,946 tons, as per Secretary of the Treasury's report, House document, No. 122, for 1841, p. 3.

Boston Transcript.

Railway Wheels.—Mr. Phipps, of Deptford Green, Engineer, has obtained a patent for improvements in the construction of railway wheels, the object of which is to supersede the process of "shrinking on," which he proposes to do in the following manner:—

A bar of wrought iron is prepared, by rolling in the usual manner, with an outer flange on one edge, and an inner flange in the centre of the bar; this bar is bent into a circular form, and then welded. Sixteen wrought iron spokes are prepared, with an extended end or palm, which may be drawn out by hammering, or welded on; the inner end of each spoke is jagged or perforated, in order that the cast metal may embrace and hold it fast. Eight of these spokes are then laid in a mould, and one portion of the boss or nave of iron cast upon their inner ends; the other eight spokes have the corresponding portion of the boss or nave cast upon them. The two parts of the nave are the brought together, and secured by screw bolts, and the enlarged ends or palms of the spokes strongly secured to the alternate sides of the inner flange by screw bolts, or by riveting. Another method consists in placing all the spokes in their respective positions around the wheel, and casting the boss or nave in one piece, the palms of the spokes being afterwards riveted to the inner flange.

Another patent has been granted to William Losh, Esq., of Little Benton, Northumberland, for improvements of railway wheels, by the application of wood, felt rope, or other such like flexible or yielding material, between the inner tire and the ring or felloe, or bearings produced by the prolongations of the bars of iron employed to make the wrought iron spokes, with or without the intervention of a ring of malleable iron between such bearings and such flexible or yielding material; by which means wrought iron railway wheels will be less liable to be prejudicially acted on by the vibration to which such wheels are liable when in use, than if they were composed of iron alone. The wheels to which these improvements are applicable, are those included in the patentee's former patent, of August, 1830.—*Civil Engineer and Architect's Journal.*

Narrow Escape of a Railroad Train.—The Newburyport Herald contains a thrilling story told by Mr. Rogers, the Architect, about the removal of one of the ponderous pillars of the Boston Exchange from Quincy to Boston. The mass weighing 60 tons was drawn by 70 oxen, and on arriving at one of the railroads just before night, the gate being closed and every thing quiet, Mr. Rogers started to push across. When the train was about half way over, the cars appeared in sight, coming at the rate of 20 miles an hour.

It was dark, and no warning to the train could be given. To turn back was impossible, and the only hope was to strain every power to bring the pillar over before the train could come up. On they urged the sluggish beasts, goading them to their utmost strength;

but as they were pushing forward, the chain that held them in one line parted ; it was an awful moment, but there was no time to unite the broken chain, and those still united to the pillar were driven and urged with a desperation that the terrible alternative required. On they went and onward came the cars, the whistle and the bell giving useless warning to beware, while those aboard were wholly unconscious of the fearful danger before them. On urged the stone, its car creaking and groaning with the ponderous weight, and it had barely cleared the rails a few feet, when the train flew by and passed on in the darkness, and the anxious and horror struck men, who had charge of the pillar, wiped the sweat from their brows and breathed as though they had themselves just escaped from a dreadful death.—*New York American.*

DISTANCES ON THE OHIO AND MISSISSIPPI RIVERS.

From Pittsburgh to

	Miles.			Miles.	
Middletown,		11	Fort William,	10	524
Beavertown,	18	29	Madison,	13	537
Fawcetstown,	19	48	Westport,	21	558
Steubenville,	22	70	Jeffersonville,	22	580
Wellsburg,	7	77	Louisville,	1	581
Warrenton,	6	83	New Albany,	5	583
Wheeling,	9	91	Leavenworth,	54	660
Elizabethtown,	13	104	Stephensport,	33	674
Sisterville,	35	139	Rockport,	53	726
Newport,	17	156	Owensburg,	8	734
Marietta,	16	172	Evansville,	35	769
Parkersburg,	12	185	Henderson,	11	780
Bellville,	17	203	Mount Vernon,	22	802
Letart's rapids,	30	232	Carthage,	12	814
Point Pleasant,	29	261	Shawneetown,	16	830
Gallipolis,	3	264	Cave in Rock,	41	871
Guyandott,	34	298	Cumberland river,	41	912
Burlington,	7	305	Tennessee river,	11	923
Portsmouth,	41	346	America,	36	959
Manchester,	36	382	Mouth of Ohio,	11	970
Maysville,	10	392	New Madrid,	65	1035
Ripley,	7	399	Little Prairie,	30	1065
Augusta,	9	408	Memphis,	119	1184
Point Pleasant,	15	423	Arkansas river,	172	1356
Cincinnati,	26	449	Vicksburg,	284	1640
Lawrenceburg,	24	473	Natchez,	103	1743
Aurora,	4	477	St. Francisville,	139	1882
Rising Sun,	7	484	Baton Rouge,	34	1916
Frederickburg,	20	504	New Orleans,	131	2047
Vevay,	10	514			

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MECHANICS' MAGAZINE.

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[For the American Railroad Journal, and Mechanics' Magazine.]

SOME REMARKS ON THE MANUFACTURE OF BAR IRON IN NORTHERN NEW YORK. *By* W. R. CASEY, *Civil Engineer.*

The manufacture of iron is a subject to which, judging from English journals, the Civil Engineers of that country pay much attention, and as its use is rapidly on the increase here, and as its importance in a national point of view is continually alluded to in the public prints, the writer has been induced to offer the following remarks, which may perhaps interest some of the profession whose acquaintance with the manufacture of this metal is as slight as his own was till lately; by which, however, he means to intimate no more than that his present knowledge of the subject is still exceedingly limited.

The ordinary mode of making wrought iron in England and Pennsylvania is generally known, but, as this requires immense quantities of coal and as none is found in this State, and as the ore here is entirely different, the mode of producing iron directly from the ore patented in England, by Mr. William N. Clay, by which a very small quantity of coal or charcoal is required with *such* ore, becomes of almost vital importance to northern New York; for, though the forests might last for ages, the expense of transporting coal to the works would necessarily limit the manufacture, when as now 300 bushels of charcoal per ton are required, while, by Mr. Clay's plan, 5 bushels would be sufficient for the first process, dry wood answering for the remaining operations,—the entire quantity of fuel being less than one-fourth of that required by the present mode, with a greater yield of iron from the same quantity of ore as well as a better quantity. The following extracts are from the remarks by the patentee, in the Civil Engineer and Architect's Journal, 1839, page 17.

"Iron is popularly divided into two descriptions, cast and wrought.

"Cast or pig iron, is principally a combination of the metal with carbon, which it absorbs from the coke or charcoal of the blast furnace. Wrought iron has been hitherto produced by freeing cast iron from the carbon, etc., with which it is combined: the nearer it approaches to a state of purity, the better wrought or malleable iron will it be.

"The richer ores of iron contain the metal combined with oxigen; if that oxigen were separated, the metal would be in its malleable state as wrought iron.

"And yet, the advance of science has left this great branch of our national prosperity so far behind, as to suffer the manufacturer still to continue the practice of impregnating the iron with carbon in the first instance, which carbon must afterwards be separated, by tedious and expensive processes, to produce wrought iron of good quality.

"But there are other evils in the common mode. It is necessary for the manufacturer to have a sort of glass floating on the molten iron at the bottom of his furnace, to prevent the oxidation of the recently produced metal by the blast. This glass is formed from the earths with which the ores of iron are mixed, and limestone to flux those earths: so that, ores of a very superior quality cannot be used by themselves, but only in part, to enrich such poor ores as have more earths combined with them than are necessary for their own fusion. Thus it is that the Hematites, and other rich ores, found abundantly in Lancashire, Cumberland, Cornwall, etc., reach no higher a marketable value at the place of their production than the common earthy ores of the coal districts, although they contain twice as much iron, and that iron of a very superior quality.

"It is the object of the patent taken out by Mr. William Clay, to produce wrought iron of best quality, direct from the rich ores heretofore so little used from the causes before named, by a process simple, rapid and economical.

"To make wrought iron of such quality, for instance, as chain cables are made from, five several operations are necessary, besides the preliminary one of making the coke for the blast furnace, namely—

"1. Roasting the ore.
"2. Smelting in the blast furnace.
"3. Refining.
"4. Puddling, balling, hammering and rolling.
"5. Cutting up, piling, and rolling.

"All these processes requiring a separate application of heat.

"It is stated in the article on iron, the 106th number of the 'Library of Useful Knowledge,' a work written with great clearness, and an intimate knowledge of the subject, that 8 tons 17 cwt. 3qrs. 3lbs. of coals are required for the production of 1 ton of finished bar iron; doubtless, the introduction of the hot blast has reduced the consumption of fuel in the smelting operation considerably, and the adoption of anthracite coal may decrease it still further. It seems, however, yet doubtful, whether the best bar iron can be produced from 'hot blast pig:' at all events, very small proportions of that description are as yet used in the fabrication of iron of superior quality.

"On the patent plan the operations are reduced to three; namely—

"1. Reducing, or preparing the ore in retorts, or other close vessels.
"2. Balling hammering and rolling.
"3. Cutting, piling and rolling.

"The first of these processes is accomplished by the otherwise waste heat of the two latter, so that only two separate applications of heat are required; and the second operation on this plan commences with the iron in as forward a state as the fourth of the old mode, whereby the cost of fuel and labor, and the enormous outlay of capital in land, blast furnaces and machinery required to bring iron on the old mode to the third stage, are all avoided.

"It is now necessary to state how this is to be accomplished.

"Refering to the plan, it will be seen that between a reverberatory furnace of the common construction employed in 'puddling,' 'balling,' or 'piling' iron, and the chimney, a range of retorts are placed, which are heated on their exterior by the otherwise waste heat of the furnace.

"Into these retorts are thrown 100 parts of Ulverstone, or other rich ore, and 20 parts of coke dust, ground charcoal, anthracite or other carbonaceous matter, well mixed together. The retort is closed, and the vapors generated escape as gas. In the course of from 30 to 48 hours, as the heat is greater or less, the carbon will carry off the oxigen, and leave the iron in a metallic state.

"It has then to be taken to the balling furnace, where it welds up, like scrap iron, and in 15 minutes is ready for the hammer; thence it undergoes the customary process of rolling.

"It is then cut up, piled, and rolled, and the operation terminates, with the production of bar iron of superior and extraordinary quality.

"The fourth operation of the old process, 'puddling,' takes from $1\frac{1}{2}$ to 2 hours to perform; the second operation of the patent, only 15 minutes; consequently, the consumption of fuel will be much less than if refined iron were used. It would be idle to compare the simplicity and economy of the first stage of the patent process, with the cost of the three stages required to make the iron stone into refined iron on the old mode, when we find by referring to page 28 of the work alluded to, that of the 8.889 tons of coal consumed in the whole process, 6.989 tons are used up to the refining, so that the 1.9 tons required for the subsequent operations, may be calculated on as more than sufficient for the patent plan—to which may be added (if the furnaces themselves do not supply sufficient cinders,) the one-fifth part of the weight of the ore used, to mix therewith, as carbonaceous matter.

"It now remains to notice the quality of the iron. In no one respect is it inferior to 'best common,' and in many of its properties it is equal to Swedish or charcoal iron; its tenacity is so great, that of four trials made with patent iron (1 inch chain,) at the corporation testing machine, Liverpool, not one broke with a less strain than 26 tons, and one link required 28 tons $12\frac{1}{2}$ cwt. to break it, the standard test for that size being 16 tons.

"Experiment on Mr. Clay's method of making bar iron,—150 lbs. of Uverstone ore and $40\frac{1}{4}$ lbs. of wet coke (losing $12\frac{1}{2}$ per cent. in drying) were put into one of the gas retorts in Dale street, on Saturday, November 24, at five in the morning, and remained in till ten on Tuesday evening, or 65 hours. The heat was maintained at a full red, or common gas-making heat. The above quantity reduced at the Mersey forge (two miles distant) produced in 34 minutes two balls of iron—one of 32 lbs., and one of 26 lbs.—58 lbs. The former rolled to $1\frac{1}{4}$ inch puddled bar, weighed 30 lbs., and was then brought down under the tilt to $\frac{3}{4}$ inch square, and samples taken when broken. The yield $38\frac{2}{3}$ per cent."

The mode in use in northern New York is, with the exception of the hot blast, the very same as that practised in England several centuries since as decribed in the Cabinet Cyclopœdia The ore, which is nearly pure oxide of iron, is taken from the mine to the forge without any preparation (from the best mines) and is sprinkled on the burning charcoal through which it passes, and being *very nearly* in a state of fusion, the particles adhere to each other; when a sufficient quantity is collected it is taken out and put under a trip hammer to drive out the cinder and consolidate the mass. Before hammering it is called a "loop," afterwards a "bloom." It is then hammered or rolled into bars, etc. Now, it will be easily seen, that if the loop be too much heated, carbon will be absorbed and cast iron will be the result, so that when put under the hammer it flies in every direction, hence great skill is required in the "bloomer" to know the exact time of taking out the loop. But, even with every precaution, it appears to the writer that a considerable portion of the loop must be consumed, for, as the ore passes through the charcoal, the latter absorbs the oxigen, pure iron then remains, which, it is well known, burns rapidly away, and as the loop is for some time exposed to a great heat, he thinks this will in part, at least, account for the great consumption of this rich ore—2 to 2½ tons per ton of bars. The uncertainty as to the quantities of coal and ore required to produce a ton of iron is proof of some varying cause of loss, but whether the above explanation be sufficient or not it is for better judges to say.

As steel is composed of pure iron and a two or three hundredth part of carbon, it will be seen, that by exposing the loop to the charcoal a little after it is in the best state for malleable iron, but not long enough to unite with sufficient carbon to become cast iron, a kind of steel would be produced, and this has repeatedly happened, though only a single instance is known to the writer of such steel having been actually *used*. Cast iron, malleable iron and steel were made from the same ore at Adirondack, in Essex county, and a mechanic, now in this city, used an accidental bar of steel for cold chisels, pronouncing it equal to the best English. Whether there is any probability of uniformly producing such steel in the forge is a question of interest and perhaps difficulty,—certainly to the writer, who is unable to offer any opinion on it. Professor Emmons, the State Geologist, considers it practicable.

Castings made from the so called "steel ore," found at Duane, in Franklin county, have the property of tempering and take a fine edge. Some time since, this steel was tried at the works of the Peru iron company, but after cutting a few nails the edges chipped off, it appeared sufficiently hard, but having no fibre was necessarily deficient in tenacity and strength.

This kind of cast iron is well known in England, where it is run into knives, scissors and other articles of cheap cutlery; these are then rendered malleable, by a process well known in this country, finished and hardened. An inquiry into this subject of any experienced and respectable importer of hard-ware, would have saved the State Commissioners and other functionaries the mortification of announcing, as a grand discovery, a physical impossibility,—these castings were to possess *all* the properties of the best cast steel! Where would the fiber strength, elasticity and malleability of steel come from?

Trials on a small scale have been made by Mr. Clay's process, and pieces containing half a cubic inch, after being subjected 36 hours to the action of charcoal at a red heat only, have been then heated to a welding heat in a blacksmith's fire and drawn out into excellent iron. Such small fragments of ore, after parting with their oxigen, may be considered as scrap iron, and formed into bars in the same manner, by heating them in a "balling" or "puddling" furnace to a welding heat and then drawing them out under the hammer.

If the ore be exposed too long to the action of the charcoal, more especially at a high temperature, it will, after losing its oxigen, combine with carbon and pass through the different stages of steel and the various grades of cast iron to the carburet. Of course nothing but experience can enable us to say what time and heat are required to completely de-oxidize the ore, when it should be immediately taken out of the charcoal, being then in a state of pure iron, except a very small portion of earthy matter which is driven out by the hammer. Hence the purer the ore the better by this mode, while by the ordinary mode, rich ores cannot be worked as explained by Mr. Clay. It would appear possible by this process to produce steel directly from the ore, but whether it would be uniformly equal to steel made by the ordinary process of "cementation," where bars of the best manufactured iron are subjected to the action of heated charcoal for a long time, it is useless to conjecture, as numerous successful trials on a large scale can alone decide it satisfactorily. In the meantime, the fact that excellent steel has been made and actually used for cold chisels, and the, as far as the writer is able to judge, clearness and simplicity of Mr. Clay's theory and process would appear sufficient to warrant some well conducted experiments.

The bloomers are paid by the ton as in England, but are not, as there, obliged to account for the ore and coal consumed; hence, if by neglect or ignorance, they use 50 bushels of charcoal to destroy 2 or 300 weight of ore, the loss falls on the proprietor. Indeed, with the common forge, it would appear impossible to attain anything like regularity in the yield of iron to the ore and coal consumed, as the entire process is carried on in the dark, and everything depends on the skill of the bloomer, whose only object is to turn out the greatest quantity of iron in a given *time* without reference to the *coal* and *ore* used, in which the employer is only interested. The writer was often led to observe that the English term for the latter "iron-master" was, in northern New York, much more applicable to the former. Now, Mr. Clay's mode, by divesting the manufacture from all mystery, by rendering the greatest possible yield almost certain, by improving the quality, by immensely reducing the consumption of fuel and by simplifying the manipulations must place the counties of Clinton and Essex among the most productive in the State; for the quantity of ore is inexhaustible, and the quality at least equal to any yet known in this country. Should the process of making iron from the rich, almost pure ores found in the primitive rocks only, succeed as well as the inventor anticipates, no coal region can compete with these counties in the manufacture of fine bar iron, boiler plates, chain cables, etc., for these would be produced of the best iron in northern New York as cheaply as of the common iron made from the course ores of the coal districts of Pennsylvania; though the latter would furnish pig iron for ordinary purposes more cheaply than the former. Pennsylvania has also the advantage of having coal and ore distributed over an immense extent of country;—on the other hand, the *very* rich ores of northern New York are confined to few localities. These circumstances would indicate that the former State is adapted to the production of an unlimited quantity of cheap iron, of which the consumption is immense; the latter State to the production of the best qualities of bar iron and steel, which are of great value, though the consumption is comparatively small in quantity. The present state and extent of the trade will be given in a future number.

New York, *April*, 1842.

[For the American Railroad Journal and Mechanics' Magazine.]

BALTIMORE AND PHILADELPHIA RAILROAD AND RIVER LINES. REPORT FOR 1841.

In these times of general depression or rather of total wreck, it may be as well to record the actual condition of the main lines, and to show to what it is owing that they are in part or in whole failures. The railway portion of this line, particularly between Philadelphia and Wilmington, was completed in a very great hurry, and therefore has had its annual outlay for repairs much increased, and it is only now in the fourth year after the opening of the entire line, that the road and its superstructures have attained a substantial character, and which with very slight exceptions in regard to some of the smaller bridges, will be the means of much saving hereafter.

The 95 miles of railway with depots, motive power and all appliances cost, - - - -	$4,588,300
The river route, including 16 miles railway, between Frenchtown and New Castle, and steamboats, etc.,	727,600
	$5,315,900

The capital stock is, - -		$2,818,300	
The loans are, at current dates,	$189,700		
" " Due June 1, 1842,	700,000		
" " " April 1, 1842–'43, sterling bonds,	502,200		
" " " In all, 1843, to State of Delaware,	80,800		
" " " February 1, 1844,	798,800		
" " " November 1, 1850, sterling bonds,	226,100		
		$2,497,600	
			$5,315,900

The receipts in 1841 for travel were on 234,739 way and through travel, or 94,725 through travel, $4,		$378,900
Freight by railroad, - - - - -		44,800
Mail, - - - - - - -		30,600
Toll and rents, - - - - - -		7,700
Travel and freight on river route, - - -		142,000
		604,000
Expenses on both lines, which is stated to include much new work, more properly belonging to construction account, - - - - - - -		308,000
		296,000
Deduct interest on loans, - - -	$150,000	
Dividend in August, 1841, 3 per cent. (the last.)	85,000	
		235,000
Applied to liquidate current loans, - - - -		$61,000

The average repairs of road and maintenance, etc., for the last three years, have been, on the Philadelphia and Havre de Grace division, 60 miles, - -	$500 per mile per an.
Havre de Grace and Baltimore division, 33 miles, - - - -	$458 " "

The latter division includes their long bridges, and is a moderate charge compared with the apprehensions at first entertained, and the whole line of road is now reported in thorough repair.

This enterprise has had every disadvantage to contend against,—obliged to use horse power at *either end* and a steamboat in the middle,—with two sets of machinery, the expenses have necessarily been very heavy, besides the delays and inefficiency occasioned by a want of continuity in the linc,—the feature above all others of *most value* in these costly enterprises, and yet which is found to obtain so little or rather not all on any of the great avenues. The river line is entirely superfluous, and is only so much dead weight. It is to be regretted that their charter compels them to run both lines. To add to all this, the bulk of the loans have been at short dates, falling due in the very crisis of the monetary difficulties of the country, and is the main contributing cause to the stock now selling at $10 for $50 paid.

The business on the road has been at a steady rate of 8 to 10 per cent. increase per annum, and an important accession to it will be found in the completion of the Baltimore and Ohio railroad to Cumberland, expected in the fall of 1842.

It is stated that much economy has lately been introduced in the management of this line, and it now only remains for them to have their loans put on a proper footing, to re-establish the value of the stock, which cannot fail to yield 6 per cent. per annum on the par value of $50 per share.

[For the American Railroad Journal and Mechanics' Magazine.]

CAMDEN AND AMBOY RAILROAD AND DELAWARE AND RARITAN CANAL.—TRANSPORTATION COMPANIES.

The first report of these joint companies was made in January, 1840, and a second has recently appeared giving a statement in continuation of their operations down to December 31, 1841.

The length of road with branches and turnouts is 98¾ miles, costing, equipped as per report, - -	$3,220,000
The length of canal is 43 and feeder 22 miles, costing, equipped as per report, - - - -	2,830,000
	6,050,000
In June, 1836, the Trenton and Philadelphia railroad, 30 miles, was added to this concern, to share equally in all dividends, at a cost said to be about, - -	999,600
	$7,049,600

The annual interest on the loans as part of the above cost is stated to be $189,600, and which are payable at long dates. The railway got into full operation between New York and Philadelphia in the year 1833, and the following statement will show the progress of business since that period on it and the canal:

Year.	Passengers.	Freight in tons.	Gross receipts.	Expenses.	Nett receipts.
1833,	109,908	6,043	$468,142	$287,091	$181,050
1834,	105,418	8,397	546,993	313,261	233,731
1835,	147,424	10,811	679,463	317,491	361,971
1836,	163,731	12,508	770,621	363,344	407,276
1837,	145,461	10,642	731,995	359,510	372,484
1838,	164,520	11,765	754,989	355,249	399,740
1839,	181,479	13,520	685,329	258,043	427,286
1840,	162,690	11,207	645,008	285,406	359,602
1841,	162,810	14,579	760,255	355,538	404,716
	1,343,441	99,472	$6,042,795	$2,894,933	$3,147,856

The canal appears to have commenced operations in 1834, and its receipts and expeditures are given as follows:

	Tolls.	Expenditures.
1834, - -	$11,604	$49,243 (1834 and 1825)
1825, - -	47,141	
1836, - -	54,801 - - -	34,764
1837, - -	67,194 - - -	27,079
1838, - -	73,507 - - -	46,007
1839, - -	52,643 - - -	53,248
1840, - -	79,467 - - -	40,769
1841, - -	81,543 - - -	49,509
	$467,900	$300,619

In the above expenditures on the railway is included the transit duty to the State of New Jersey, equal now to about $25,000 per annum; deducting this, the ratio of expenses for the last two years is about 40 to 42 per cent. on the gross receipts, but under a different arrangement, might be reduced 10 per cent., considering the magnitude of the receipts.

The canal has always been, and the Trenton railway has lately become, a drag on this concern, yet with all this burden it still yields an income on the whole cost, and *by itself as a railway*, is one of the most profitable concerns in the country. The canal has now, however, the prospect of getting the whole coal trade, and the Trenton railroad will, we trust, be ere long relaid with an edge rail, and its termination carried into Broad street, at Philadelphia, where all the other railways now concentrate. If, as the result of this, the traveller is carried between these two important cities in four and a-half to five hours, by which the day will be made available to him in either, fresh inducement will be given to travel, even though the fare be kept at the high rate of $4 per head, which would then be the more cheerfully paid, and is even now preferred as the cheapest by a majority, as appears by the returns of 1841, when

90,000 passengers passed over the Jersey railway, through Brunswick, at $4.

72,800 passengers passed over the Camden and Amboy railway, at $3.

162,800 through passengers by both lines.

The charges for freight between New York and Phildelphia, on the Camden and Amboy line, are complained of as too high, and naturally enough, when at the adjoining wharf goods are carried to Boston by a similar mixed conveyance $5 to $7 per ton, for 230 miles, and are here charged for little over one-third of that distance $15 to $20 per ton; the same contrast applies between other points in even a stronger degree. Quantities of goods, such as hemp, rattans, etc., are often sent by sea at $8 per ton including insurance, when $10 has been offered in vain to this railway. Its charter does not allow of a higher charge than $8 per ton, and the 14,600 tons carried in 1841 are credited to it at about $9, while the average charge cannot be much less than $16; the difference being charged by the "*Union Transportation company*" for the distance by steamboat of 30 miles to Amboy. It is strange enough, however, that the board of directors of the railway approve of this system in the following terms:

"The great and growing importance and value of this business has deeply occupied the most serious attention of the board, to ascertain to the greatest certainty the most advantageous and profitable mode of conducting it. They believe that in no other way than the one in which it has been conducted for some years past, by the intervention of other parties, could so large a revenue have accrued to the companies. By the existing arrangement with the New Brunswick steamboat and canal transportation company, this whole business is done by them. The joint companies avoid all liabilities for losses or damages to property passing over this road or in their boats between New York and Philadelphia, and at a less cost than a commission of 5 per cent. on the business would amount to."

Still it is not so clear to our apprehension, that this system of "*imperium in imperio*" can answer any better in the management of the railway, than it has been found to do in the government of a State. A nearly similar system, as regards the "*forwarding men*," on the Columbia railway, has lately been condemned by the Canal Commissioners of Pennsylvania.

The charges by the canal route, by the same *sub-company*, are more moderate and consistent, but might still be modified so as to get much more of the freight now sent coastwise,—lower rates by the railway would command it nearly all.

The measures proposed by this company for securing the coal trade through the Delaware and Raritan canal are judicious, and are explained in the following extract:

"Experience has demonstrated to general satisfaction, that the cheapest, safest and most expeditious route to New York is by the Delaware and Raritan canal, and the completion of the Reading railroad will add still greater facilities for the transportation of coal through it. Four iron steamboats, with steam engines in each, with the capacity to carry 230 tons of coal each, are now being built by individual enterprise for the purpose of transporting coal to New York and eastward.

"It is proposed to establish depots at Amboy, etc., and to offer to vessels purchasing coal at these depots for eastern ports, a bounty in the form of payment to them of 10 cents on every ton of coal so purchased by them; and to transport such goods as they may be loaded with, destined for Philadelphia, over the Camden and Amboy railroad or by the Delaware and Raritan canal, at rates so reasonable as to ensure the business."

One of the great benefits of this coming revolution in the coal trade, as the effect of the Philadelphia and Pottsville railway, is seen in the reduction of the freight and toll between Pottsville and New York, charged at one time last year as high as $5 20 per ton, but now offered to be done for $2 50 to $2 75 per ton. A still further reduction will be effected on the introduction of the iron steam barges alluded to above, the cost of plying them between the coal wharves, on the Delaware, and New York, to and fro,—130 miles tideway, 86 miles of canal,—being about as follows:

Cost of iron steam barge $7,500 at 6 per cent. interest per annum, making a trip every 5 days, say 45 trips per season, is per trip, - - - - -			$10 00
Renewal of steam engine, (the boat itself being nearly everlasting,) per trip, - - - - -			6 00
Engineer and firemen and victualling per trip, -			15 00
Fuel, (coal dust, at $1 per ton, may be used) per trip, - - - - - -			7 00
Unloading boat, using machinery at 6 cents per ton,			12 00
			$50 00
Two hundred tons of freight is per ton, - -		25	
Toll to the Delaware and Raritan canal, - -		25	
			50
Cost of a ton of white ash at the mine, including profit, - - - - - -	$1 25		
Freight per railway delivered into barge on the Delaware, - - - - - -	1 50		
Shipping charges, - - - - -	25		
			3 00
Cost of coal afloat in New York, - - -			$3 50

At this rate of cost, the Schuylkill white ash coal could be afforded to advantage in New York afloat at $4 per ton, or cheaper than from any other source,—and an interesting fact in regard to the economy of this fuel is given in their last report, which states that in one of their steamboats the consumption of coal was at $10 per day, as compared with $27 per day with wood.

[For the American Railroad Journal and Mechanics' Magazine.]

PHILADELPHIA AND POTTSVILLE RAILWAY.

By a report from the engineers of this company, Messrs. Moncure and Wirt Robinson, dated December, 1839, the following particulars in regard to the cost of this road are given:

88 miles of single track between Pottsville and the Columbia railway bridge, at Peter's island.				
$6\frac{1}{2}$ miles of double track between the falls of the Schuylkill and the wharves on the Delaware, at Richmond.				
$94\frac{1}{2}$ miles, or equal to 101 miles of single track, total cost, including everything, *having an edge rail, and graded for two tracks*, - - -				$4,353,000
Cost of locomotives and cars up to January 1, 1840, - - - -			$188,000	
Required further for the coal business, say 20 locomotives, at $7,500 each, - -		$150,000		
1,300 cars, at $250 each, -		325,000		
			475,000	
				663,000
Equal to about $50,000 per mile of single track with machinery, - - - - - -				$5,016,000

In the above cost, the charge for right of way averages about $2,500 per mile for the whole distance.

In the history of this road, it will be of interest hereafter to know that, when almost broken down and nearly in reach of its final object, *the coal mines at Pottsville*, and when its numerous enemies were most certain of its failure, the Bostonians on the one hand, and the Baltimorians on the other, uniting with its few friends in Philadelphia, supplied the requsite means to insure its completion, while New York, the most interested in its effects, did not contribute a cent. Its opening on the 10th of January, 1842, was the overthrow of the canal monopoly in the carriage of this important staple. The great mass of the Schuylkill coal operators till now beggared, in being the sport of so many contingencies, will hereafter go on to prosper under *steady and moderate* prices, and with the blessings of many a poor man and his children, who till now could but seldom enjoy the great comfort of a warm fire.

It is common to speak of this road as a very dear one,—it is seemingly a very costly one,—but for this *full value* has been obtained in the substantial character of all the work on it, and the facilities given to it for cheap transportation; which we confidently expect it will soon be able to demonstrate, by its annual expenditures showing a smaller per centage on its gross receipts, than we have as yet been accustomed to. Time, we believe, will show that the engineers of this road have acted on the truth of the following sentiment in a line of Pope, in matters of this sort, that,

"'Tis only usefulness that sanctifies expense."

[For the American Railroad Journal and Mechanics' Magazine.]

ADVANTAGES OF A CONTINUOUS RAILWAY FROM THE COAL MINES TO TIDE-WATER.

The coal trade of the Schuylkill is now destined to the following points of consumption:

The city of Philadelphia and vicinity takes about, -	100,000
The city of New York and vicinity, via. the Delaware and Raritan canal in barges, - - -	250,000
The cities of Boston, Providence and eastern and southern coast in vessels by sea, - - - -	200,000
Total tons, - - - - - -	550,000

There being now two avenues to tide-water in the choice of the operator, the *canal and railway,* what are the transportation and incidental charges by each respectively, and by which will the larger amount of trade be done ultimately, when the railway is made to operate with all its efficiency?

The canal,—

Now charges for toll, - - -	54		
The freight say, affording a mere living, -	90		
		$1 44	
Incidentals, wastage on the canal and piling a portion on the wharves, - -	36		
Use of Pottsville landings, - -	12		
Shipping into vessels on the Schuylkill by wheelbarrows, - - - -	25		
Wharf rent clerk hire, etc., - -	12		
		85	
Amount carried over, - - -			$2 29

Amount brought over, - - -			$2 29
The railway,—			
The toll and freight, delivered at Peter's island or on the Delaware, - -		1 50	
Incidentals, wastage, shipping charges, wharf rent, etc., applicable to delivery on the Delaware, or to cover toll over State road into Broad street, and yard rent, etc.,		44	
			1 94
Difference in favor of railway in the mere items of transportation, - - -			35
To this difference may be added the following items, which indirectly operate favorably to the trade by the railway:			
1. The use of the Pottsville landings not required, - - - -	12		
2. The lateral road cars and boats not required, saving in capital, etc., equal per ton, - - - - - -	10		
3. The use of less capital required to trade on the railway, which will be enabled to give the operator a fortnight credit on the toll and freight of $1 50 per ton, leaving only the *first cost of coal at the mine,* say $1 per ton for white ash, to be provided, which, with the freight at least on the canal, say $2, must be *cash,* saving, -	6		
4. Gain, in being able to turn *one dollar* on the railway *three* times, while the *two dollars* on the canal can be turned only *once.* These two last items of vital importance in reference to money facilities hereafter, - - - -	15		
5. Saving by the avoidance of any *heavy dead* stocks in winter, comparatively, and an uninterrupted employment of capital during the whole year, equal to per ton,	12		
6. Difference in favor of Broad street as a depot for *retail at Philadelphia,* over the wharves on the Schuylkill, a horse being able to deliver 15 tons per day from Broad street to 5 from the Schuylkill, -	20		
Amount carried over, - - -		75	35

Amount brought over, - - -	75		35
7. Time saved by shooting from the cars, loaded at the mine, into vessels or barges on the Delaware, being as 3 to 1 compared to the *tedious process* of loading by the wheelbarrow, as on the Schuylkill, -	10		
8. Difference in value of coal consigned to New York in *barges* over that by the only mode of shipping by vessels on the Schuylkill; in the former it can be ready screened for delivery at once from the barge to the consumer, and in steam barges with the power of locomotion in themselves, the difference will be still greater, and although 25 cents has often been paid, say, per ton, - - - -	15		
	——	1 00	
Total difference in favor of the trade by the railway, - - - -		——	$1 35
Deduct present toll on the canal, - -			54
Difference in favor of the railway *over and above* any toll on the canal, - -			81

In thus reducing these indirect items in favor of the railway to figures, it is not pretended that it can be done very accurately, but that *they exist and sufficiently* to give the railway the command of all the trade it can accommodate, can hardly be denied. The ability of the road to deliver, as a *business load*, 150 to 200 tons by one engine of *the lighter kind*, and that without any waste of coal, at first so stoutly denied by its opponents, is now fully established, and with these are its claims to cheaper transportation than by canal, equally established. So again, as time is given to the road to develope itself, will it also be discovered that the indirect items just enumerated in its favor are more or less well founded; and the canal will not be able to contend against the railway, except under an arrangement, by which the latter shall put its rate at a level that will allow the boatmen to earn about $1 per ton, and the canal to maintain a toll of 50 cents per ton. This level by railway is between $1 75 to $2 per ton, and then by both avenues will it be practicable to maintain a preponderance of the trade in the Schuylkill valley, and still afford the coal to the consumer at a rate lower than has yet obtained, and be a wholesome check on the competition from other regions, while a steady and moderate rate of price will be maintained all round.

[From the Civil Engineer and Architect's Journal.]

MR. VIGNOLES'S LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.—ON ARTIFICIAL FOUNDATIONS.

Lecture I.—*November* 25, 1841.—After offering some comments on engineering generally, the lecturer alluded in particular to that important portion where the skill of the engineer was most required—viz. foundations. After some instructive remarks upon the subject, he said that for the foundation of bridges a network of timber had been used, and was found to be very good so long as it was under water; but if it were liable to become dry, and exposed to the effects of the atmosphere, it was sure to fail. He recommended concrete as far superior to timber; he had seen concrete forced into a quicksand, and no weight could afterwards force it out. Brick, earth and clay form excellent foundations—the whole of St. Paul's, except the northeast corner, was built upon such a foundation, of from four to five feet thick; at the northeast corner, the architect being afraid to trust to the ground, it being rather softer than the other parts, had the clay removed, and a well of from twenty to thirty feet square sunk to a depth of about forty feet, where the hard bed was found; he then raised a solid mass of masonry to within nine or ten feet of the surface—arches were turned, and the foundation finished at an enormous expense; whereas, a few cubic yards of concrete would have answered equally well, if not better. All must have noticed the hole that was filled up in laying the concrete foundation of the Royal Exchange; there a few cubic yards of concrete did the work more expeditiously, and as well as the ingenuity of the mason could have effected it; he alluded to some of the most remarkable instances of the prodigality of architects in laying foundations, as the Barriere de l'Etoile (a trumphal arch at Paris,) where the cost of the foundation far exceeded the amount of surface work; and the viaduct of the Valley Flore, in which a mass of solid masonry, thirty feet thick, was erected, extending all across the valley. In these cases concrete would have answered the purpose equally well, and at an enormous reduction in expense. Mr. Vignoles stated that the leading principles he wished to impress upon the minds of the students were—extension of base and equality of surface. He then, at some length, explained the different foundations that had been used for bridge building, and mentioned particularly Ranger's patent for curing defects where foundations have given way—viz. by using hot water to concrete applied in boxes, the hot water causing the concrete to expand. This was applied to the foundation of the custom house when it had given way in consequence of a failure in the piling, which rendered necessary the application of an artificial for a natural foundation. He then remarked upon the various methods now in vogue for keeping the piles of bridges dry while under repair, alluding to caissons, and Mr. Tierney Clark's method of putting in the foundation of the landing place at Gravesend by portable coffer-dams. The professor concluded his instructive lecture, stating his wish to popularise the knowledge of engineering as a means of benefitting the public at large.

Lecture II.—*Wednesday, December* 1, 1841.—In the first lecture Mr. Vignoles gave the general principles of the various descriptions of foundations; in the present, he proceeded to illustrate those principles by diagrams. He stated, that if a good foundation were provided by nature, the subsequent operations were simple, the main point being to imitate nature as closely as possible. Where the soil was bad, considerable skill was required; for instance, in laying the foundation for the pier of a bridge, a wall, or a column, the first point was to give the base extensibility, in proportion as the natural soil was weak, so in equal proportion must the size of the base be increased—the pressure must also be equal; the soundness of the foundation not depending so much upon the amount of settlement as upon its equality. There were various ways of obtaining this—viz. by the use of concrete alone, or in conjunction with timber, timber alone, or stone, or brick. Having so much insisted upon the necessity of an uniformity, it must be supposed that no portion of the artificial soil should escape; where that was likely, *sheet piling* must be restored to. He then, by means of diagrams, explained the nature of that method—it being by driving piles close together, all round the foundation; the piles being (say) four inches thick, and as long as might be necessary. This method entirely prevented the escape of the soil in any manner but in a vertical direction, and ensured an uniform sinking, however bad the natural soil might have been. He then alluded to a very large chimney, twenty-two feet square, where the natural soil was a shifting quicksand; concrete was put in in layers, until the bed was eight feet thick; on this was placed a layer of flag-stone, five feet square; eight days after the work was completed, the whole sunk eighteen inches, without the least deviation from the perpendicular. Other modes had been adopted, among which was the following:—A number of timber balks were laid across, and concrete placed in the spaces between; then filled up with bricks; timbers were laid in a cross direction, and the flat stones placed upon them. In this instance the wood was laid where no change of atmosphere could effect it. The nature and use of a coffer-dam was then explained, and the professor, at some length, showed the danger of incautiously drawing the piles; the vacuity occasioned by their withdrawal being filled up by the surrounding matter, greatly injured the stability of the foundation. In making one of the London bridges, a great disfigurement had occurred in consequence of the incautious withdrawal of the piles, one side of the pier having sunk one foot. The modern plan to prevent such accidents was to have a double coffer-dam—the piles of the inner one being cut off, and the outer piles might be withdrawn without danger. In laying foundations, he supposed there was a layer of soft ground, of moderate depth, with a hard substrata; piles must be driven through the soft soil into the hard bed ; a very slight depth would be sufficient, but still, in most cases, sheet piling would be necessary.

The professor said that he was lately indebted to an officer of the Bengal Engineers for an account of a very ingenious method, almost universally practised in laying the foundations of bridges and temples in India. It would not answer here, labor being so dear ; but there, where wood was very scarce, building materials in great plenty, and labor very cheap, it was the simplest and most effective that could be imagined. From the explanation, it appeared that the system was the same as piling, but instead of using wood, small wells of brick work were substituted. Take, for instance, the pier of a bridge,—a small well of brick work was constructed —say, six feet deep, seven feet in diameter, with a hole through it, three and a half feet in diameter ; this is placed on the sandy bed where the foundation is to be made ; a workman gets into it, and undermines the well from the inside, the earth being drawn up in buckets, additional layers are added to the top of the well until a sound bottom was reached ; and the singularity was, that there was not one or two of these little wells, but hundreds, and in certain cases, to a depth of fifty-five feet ; arches were then thrown across, and the superstructure raised. When the foundation was in the bed of a river, the excavation went on by the workmen driving through the water to the bottom of the well, and working there until obliged to come to the surface for air ; for instance, through ten feet of water in the river and to the extent of forty feet of water in the well—one of the most extraordinary instances of perseverance upon record. English engineers had somewhat abridged the labor by substituting an oblong square of fifteen feet by four feet, with two elliptical holes for the workmen, so that, instead of three wells of six feet, they get one of fifteen feet—the principle being precisely the same.

In France a number of bridges had been built where the water was not rapid, upon a very simple foundation ; a framework of timber being made, furnished with short piles at the corner, and laid in the bed of the river, and the superstructure raised upon it by means of a wooden diving-bell. The *pier perdue* was another way, but could only be used in still water ; a quantity of stones were thrown in until a foundation was obtained ; where there was any current this foundation was sure to give way, as in Plymouth breakwater and Kingston harbor. He then alluded to the case of one of the London docks, where the wall being made with too great a curve, from the want of pile sheeting, the soil gave way—the engineer adding fresh matter until the toe of the wall actually appeared (to the astonishment of all) above the surface on the other side. He then gave examples of several original methods of preparing for the formation of foundations in Italy and Ireland by means of baskets of stones, etc.

Concrete.—The professor next explained the nature of concrete, and gave directions for its formation,—viz. one part of lime, twice that quantity of sand, and twice as much broken stone or gravel as there was sand.

The goodness of the concrete depended upon the quality of the lime. In making concrete, it must be borne in mind that the materials were far more bulky separate than when mixed; for instance, to make a cubic yard of concrete, which contained twenty-seven cubic feet, it would be necessary to have thirty-four cubic feet of materials, besides the water. The three ingredients should be mixed dry, and the water added; in slaking, the concrete will expand about one-thirtieth in bulk.

The great expense of coffer-dams, and of piers generally, had lately led to a very peculiar construction of bridges by piling only, as, for instance, in iron bridges no masonry being used. The professor stated that he had built seven or eight bridges upon that system; the piles were driven in and the iron work erected upon the wood. It had been tried to substitute cast iron for piles instead of wood, but they had not succeeded, the iron being very liable to break. He also alluded to a beautiful arrangement for fixing branches to piles by means of a sliding collar, but which is impossible to explain without diagrams. A French work, above 200 years old, was produced, with some very curious engravings of the modes then in use for securing foundations, and which proved that we are using the same means at present, and that many of our so-called new processes were in use at that time. He then concluded by stating, that, at his next lecture, he should bring forward some more general rules respecting foundations, and after that proceed to consider the best method of securing slopes of earth now so generally in use.

Lecture III.—*Wednesday, December* 8, 1841.—Mr. Vignoles explained that at his former lecture he had applied the term "concrete" too generally, and would now explain the difference between "*beton*" and "concrete." Beton was formed of the usual quantity of sand and gravel, broken stones, etc., but, instead of using the ordinary stone lime, hydraulic lime was applied. He then stated that beton is used exclusively under water, concrete only where water does not get in: beton never sets until it is under water, while concrete will not set except it is dry. The lime used for beton must be first slacked, while for concrete it slakes in the process of mixing. Beton sets best when let down gently in cases, and concrete when scattered from an eminence. Beton takes months to become hard, while concrete hardens in a few minutes. They both are in purport essentially the same,—to form an artificial stone or rock,—the one for works under water, and the other for those on land. He then alluded to the knowledge of the ancients of beton and concrete, and read extracts from the works of sundry authors, from Josephus to the present time, proving that assertion. The use of piles was also very ancient, the foundation of a brick pyramid in Egypt having been constructed on that principle. After impressing upon the minds of the students the great importance of a good foundation, and the efficacy of concrete for attaining that end, he concluded, by stating that his next lecture would be again on the subject of foundations, and after that he would proceed to lecture upon slopes of earth, and explain the causes of the late accidents upon the different railways, pointing out where the errors of judgment had occurred.

Lecture IV.—*Wednesday, December* 15, 1841.—Mr. Vignoles commenced by explaining the mode in which piles were driven in, and produced a model of a pile-driving machine (from the museum of the college,) by means of which he showed the method in which steam power was applied to that machine for expediting the work, stating, however, that, far from that application being a novelty, he had used it himself twelve or fourteen years ago.

Rock foundations.—Having treated in his former lectures upon foundations in natural soils, or various kinds of artificial bases, he would now notice such as were of the composite order, being partly on rock and partly requiring artificial means to render them sufficiently sound for the required purpose. It often happens that, in making a bridge, there may be rock on both sides of the river, and the first pier may rest upon rock, while the second and third may have an insecure foundation, in consequence of a "pot-hole" (as it is called) of sand unexpectedly being discovered in the very spot where these piers are to be erected; the only plan to get over this difficulty is to cut the edge of the hole in steps; sheet pile it a short space from the wall of the hole, and fill up the intervening space between the piling and the hole with beton or some other substance, and thus form a continuation of the rock itself. Difficulties also present themselves in solid rock foundations; for instance, in such an erection as that at the Devil's bridge; the ravine over which the bridge is to be thrown may have been formed by the running of water,—the strata, accordingly, runs with the usual inclination on both sides. If foundations for the piers of the bridge were not sunk deep enough into the rock, the press of the water filtering through the fissures of the strata have such force that, notwithstanding the resistance of the arch, he had known instances of the pier being actually pushed outwards. The only method of avoiding this was to sink the pier so low into the rocks, and, by means of steps, secure it so firmly, that the force of the water must *break* the pier,—not force it outwards,—before it could destroy the bridge. The professor, before going into the question of rock foundations, begged to state, that in these lectures he only laid down the general principles of foundations; he could not go into the details of the business, and the circumstances of stone foundations were so varied, that it was only by a life of labor and experience that the best method could be arrived at; he wished that each student should, in his private study, well consider, and by reading, test the correctness of the principles which he had laid down for their guidance. A whole year's lecture, repeated every day, would be no more than sufficient to draw the attention of the student to important points—the details could only be gained by practical experience. In preparing the foundation of lighthouses, the whole resources of the engineer must be called into action. A lighthouse must be built in such a manner that it must actually grow from the rock; there are instances where lighthouses have fallen in a body. He could mention one in Ireland, the foundation of which was a solid rock; he saw a party who witnessed its fall, and who informed him that it fell in a solid mass, tearing away a portion of the rock with it. The fault was, that the foundation was not sunk deep enough into the rock. He then alluded to the celebrated Pharos (of Pharos) of Alexander, which was justly reckoned one of the seven wonders of the world; it was built about 283 years B. C., and received its name from the island on which it was built; it was 550 feet high, and the base was 150 feet square, and could be seen at a distance of 40 English miles, Josephus, and many other authors, had given descriptions of it, which pretty well agreed; and what was most extraordinary, that the very same method of making the foundation was practised then as now. The stones were dove-tailed together, dowelled, and run with lead, so as to firmly secure them in their places. The cost of the building amounted to no less a sum than £200,000 of our money, and it lasted above 16 centuries; no diminuation in its height occurred until after a 1000 years from its erection, at which time about one-third of its height was wasted away by time, and it was only within about 400 years that the whole is supposed to have been destroyed, and that only by means of an earthquake. He then remarked, that it was very seldom that the name of an engineer was handed down for 2000 years, but all accounts agreed that Sosastros was the name of the engineer who erected this wonder of the world. The celebrated Corduan, or, as it is generally called, Cordovan lighthouse, at the mouth of the Garron, is built upon the same principles as the Pharos; this lighthouse is, however circular, but the masonry is not calculated for durability, it being built of freestone. The expense of this lighthouse was enormous, as must be supposed, when millions of francs were expended upon ornament, which was the more absurd, when it was considered that it stood upon a barren rock, in the middle of the sea. He could not help quoting a line of Pope—

"'Tis only usefulness that sanctifies expense."

This is a sentiment that he wished to impress upon the minds of all his students, for it was a great fault of modern engineers to expend great sums upon ornament, which could be far better employed upon actual necessaries. He then turned to the Eddystone lighthouse, and related the histories and fates of the two lighthouses preceeding the one now standing, which was erected by the genius of Smeaton, and strongly recommended his pupils to read the account published of that great work. The Eddystone rock is peculiarly interesting to the engineer; it is found first at about one mile deep in the ocean, and then rise gradually about one foot in ten, until it reaches near the level of the sea, when a sudden crop makes its appearance, and rises above surface. From the peculiar formation of this rock, there is always a heavy run upon it, which renders it so very dangerous. The learned professor, after explaining at some length the process of the erection of this celebrated lighthouse, concluded his lecture.

Lecture V.—*Wednesday, December* 22, 1841.—*On earthwork.*—The professor commenced by stating that earthwork, taken in the present extended sense of the word was but little known to the ancients. The gigantic operations in earthwork of modern times correspond with the viaducts of the ancients. Our earthwork may be confined to excavation, cutting and embankment, or getting and filling, as ordinarily denominated by contractors. He then went through the whole process, giving the scientific and common names of each description of work. With respect to the works of the ancients, in the canal made by Cyrus, the Phœnicians were the only workmen who cut the canal with slopes—all the rest employed, cut straight down, and in consequence, the former stood, while the latter fell in. The river Po, in Italy, was a curious instance of embankment; this river is situated in a very flat country, and makes an annual deposit of a calcareous matter, which hardening, raises the bed of the river in a slight degree every year. The ancient inhabitants, to prevent their country from being inundated, were obliged to raise a small embankment on each side of the river—perhaps two or three feet high—which, having served for some years the desired purpose, and the bed of the river having become higher from the deposit, the embankments required to have still more added to them, until, after the lapse of centuries, the bed of the river, from the constant deposit of calcareous matter, and the consequent necessary additions to the embankments, to the height of thirty feet, is now several feet above the level of the surrounding country. This work looks like one of our modern gigantic works, but it bears no comparison to the labors of the present day, it being but a work performed from year to year, in small portions at a time, while ours have been formed at one operation. From all his researches, he, therefore, came to this conclusion, that, until late years, earthwork was but little known; he could make the same remark with respect to cutting. This work was first treated systematically by military engineers in fortifications on the continent after the invention of cannon; authors of that period lay down many curious rules for forming ramparts. Various useful calculations are given to determine the best mode of making the matter taken from the ditch exactly sufficient to form the rampart, in order that there should be none either to procure or carry away, the next is in the construction of canals; the same rules were followed as in the construction of ramparts. In road making the same calculations were made; the whole aim of the engineer being to make the imaginary line, called the "balancing line," so perfect, that the earth removed from the eminences should fill up the hollows in the irregularities of the country through which the road was to be made. The cause of these fine calculations was the difficulty and expense of carrying away the superfluous earth to another place. The absence of great undertakings on the continent is attributable to the want of our modern appliances to get rid of the superabundant matter. In the contracts sent in by foreigners for works abroad, it is amusing to see the finical exactness with which the contractors calculate the expense of removing the first 100 yards, then the next 25 yards, and so on increasing until they get to 300 yards, beyond which the price is enormous. It is only within the last 3 years that they seemed to have the slightest idea of the plans in use in England for facilitating this work; it is certainly not more than 30 years ago that we commenced using the tramroad. First of all, the only plan was to remove the earth in barrows, then the clumsy three-wheel cart was introduced, after that tramroads, and now edge rails, with the application of a locomotive, so that 30 years has changed the load from 2½ cubic yards to nearly 100.

Before railroads came into general use, deep cuttings were executed, and one remarkable instance Telford has left behind him in the Birmingham canal, which is remarkable for boldness of idea and success of execution. Near Market Draton there is an embankment, begun 15 or 16 years ago, and which is as yet hardly finished, so great has been the slipping and so difficult the remedy. This work is a remarkable instance of combined bad effects of a bad mixture; the slopes have flatted down until nearly in the proportion of 14 to 1, and it is now more like a large hill than an embankment. There is an instance of a deep cutting, by Dodd, at the Highgate archway; it was intended, first of all, to make a tunnel, but from the constant slipping of the earth, it was obliged to be made into an open cutting. The present bold mode of cutting down large hills and filling up deep valleys, in the formation of railways, is due to George Stephenson, and in the construction of large cuttings and embankments for canals to Telford, while Dodd made the largest cuttings for roads. On the Holyhead road the failure of the embankments and cuttings in the London clay will teach a good lesson to the young students. The point to be considered is, which, of masonry, aqueducts, tunnelling, embankments or cuttings, would be the cheapest mode of doing the work proposed. At the present time, earthwork is the cheapest, for modern practice has reduced it to a price per cubic yard. In the contracts for the Paris and Rouen railway, the contracts sent in by the French engineers were invariably three or four times the amount of those sent in by English contractors—thus, notwithstanding the expense of transporting the workmen into France, the whole of that work is in the hands of Englishmen.

The engineer, to form a just calculation, must well study the character and mechanical properties of the soil and the necessary slopes. Experience alone can teach these points. There are many varieties of the London clay, which, when cut down to a certain depth, on exposure to the atmosphere, are sure to slip; another cause is the great haste with which the embankments, etc., are formed. When the water does not penetrate, this clay is very hard, but after exposure it melts away like tallow, and the only remedy is to get rid of the water by draining. When a slip takes place, the toe of the embankment bulges forward; in the first instance, the surface should be well drained a short distance from the edge—the drain to be puddled, in order that the water should not penetrate; borings should be made horizontally and the water tapped; when expense and time are no objects, the whole should be cut in steps, and drained by means of wattles, so that, if a slip takes place, it is only partial. The force with which the toe of the embankment bulges out is such that a wall of masonry would be of no use, as it would be pushed out; the most effectual preventive or remedy, is wattling and bush drains. When time will allow, it is better to make the embankments in layers, and between each layer of earth putting in a course of brushwood, clippings of hedges or wattlings. When embankments are obliged to be poured out hastily, allow them to take their natural slope, and if it slips let it remain, for however much it may be attempted to reduce it to its former shape, it will again slip and regain its position. A good practice to provide against slips is to form a slight abutment of earth, a short distance from the toe of the slope, so that it should stay the slip if it takes place; this plan is more particularly available when the work is obliged to be erected on a natural slope—for instance, on the side of a hill. The professor then, for the information of the younger students, explained, by diagrams, the nature of slopes, and the meaning of the expression "two feet to one," etc., and concluded by recommending that, in forming slopes, the engineer should run some risk of slips, in order to save the great expense of removing more earth than is actually necessary—the cost of repairing these slips being but little in comparison. He likened the work to an insurance on life—the risk to be run being calculated upon by precedents. The principle is to get the greatest extent of work finished at the least possible expense, and many of the great slips that have taken place might have been prevented or speedily cured, had the plans he laid down been better followed.

Lecture VI.—*Wednesday, December* 29, 1841.—Professor Vignoles stated that, before continuing the subject of earthworks, he wished to set right an erroneous impression with the public, in consequence of an expression he made use of at his last lecture; he had then recommended that "the engineer should run some risk of slips, in order to save the great expense of removing more earth than was actually necessary—the cost of repairing those slips being but trifling in comparison." He need not say that he so expressed himself, but it was always on the supposition that no risk was to be run where there was the remotest probability of danger. He mentioned this because of the circumstance of the slip on the Great Western railway, which was attended with such fatal results, and happening only a few hours after he had made that statement. From all that had been stated, it appeared that the slip itself was but very inconsiderable; the cutting where it took place was 57 feet deep, the slope two to one, and the width of the road 40 feet; the slip took place about half way up the bank. A number of smaller slips had occurred, and tiles were used for draining instead of bushes, etc., to cure them—still the mode of curing them was the same as he advocated—by drainings. As he had before stated, the slip itself was very inconsiderable, but by having nothing to check it, the earth fell upon the rails. A doubt seemed to exist whether the concussion produced in the air by the passing of the former train had not brought it down, for the accident happened in the interval between the passing of the two trains—the first one having proceed uninjured, while the latter was attended with such fatal consequences. If the precaution had been taken when it was first observed that a slip was likely to occur, to put up a fence of hurdles to check its advance to the rails, doubtless the accident would not have happened. The manner of the slip showed that it was caused by the infiltration of water, probably a considerable way back from the edge of the cutting, or perhaps the water had found its way in by the ditch along the top; the water which had thus got into the soil having expanded during the frost, the sudden change of the weather brough down the earth. The professor then, by means of a diagram, explained the nature of the cutting, from which it appeared that the "top lift" was deposited in spoil bank; at the top of the cutting a drain had also been cut, but he was of opinion that such drains were injurious when the soil was at all precarious. The spoil bank was not the occasion of the slip, since it did not take place at the top, but bulged out in the middle. Although this slip was very small, from the fatal effects which attended it, it was the more necessary to guard against the recurrence of the like; there was but a few feet of earth on the rails, yet the effect was the same as if so many planks had been placed upon them. The Croyden slip arose from the same cause, but, though so much larger, no accident occurred. In the late accident there were but thirty or forty wagon loads of earth, and all was right again in a few hours, while in the Croyden slip 3,000 or 4,000 cubic yards of earth fell; the soil in both instances consisted of the London clay, with pot-holes of sand. It was clear that the accident was not to be set down as one of cutting, similar slips having taken place upon cuttings not more than twelve or fourteen feet deep. He must impress upon the minds of the students that it was not the length or the depth of the cutting which regulated the slopes, but the soil and practicability of drainage; unfortunately it was impossible to know exactly how these matters might stand, experience alone could teach them. He had dwelt long upon this subject, but he wished it to be understood that it was well-judged economy he advocated, not such as would, in the least degree, tend to produce such fatal effects as in the case previously alluded to.

The balancing of the line was equally necessary for railroads as for canals or common roads; it should be the engineer's aim that the quantity of the earth from the cuttings should be as near as possible sufficient for the embankments; compared with former times, the mode of transit was so much facilitated, that where some years back it was necessary that the balance line should be limited to the hill to be cut through, and the valley to be filled up, now the line might extend two or three miles. It was essential in balancing that the engineer should be aware of the different degrees of compressibility of the matter; it was known of sand that it would occupy the same cubic contents in the embankment as it did in the hill, and 1 yard or 100 yards of gravel would be still the same, but in clays it was very different, they occupying less space in the embankment than they did in the hill, in their original position; 100 yards of clay would not make 100 yards of embankment, the average amount of compressibility being not less than 10 per cent., or even, upon occasions, as much as 15 per cent. He had known occasions when 100 yards cut from a hill had only made 85 yards of embankment, but, upon an average, it would require 110 yards of clay to make 100 yards of embankment. Rock cuttings, on the contrary, expanded, because the solid rock could never again be restored to the same degree of density; the difference would vary much, according to the size of the fragments, but where the pieces were large, 100 yards would make 120 yards of embankments. Chalk, again, would be rather upon the excess, though much depended upon its quality. In rock cuttings you might make them nearly perpendicular, but in chalk much discussion has arisen as to what was the proper slope, some engineers having even recommended that it should overhang the road, but he contended that it should slope, to carry off the water; he had found a slope of one quarter to one generally sufficient. Rock chalk would stand perpendicular, while several of the softer descriptions would require a slope of one-half to one, or two to one.

The professor then proceeded to speak of the correct mode of computing the quantity of earth in a cutting or embankment, and made a section of a hill half a mile long, to be cut down, the true cubic contents of a portion of which was 332,000 cubic yards, computed according to the prismoidal formula; but the ordinary method by which contractors would calculate the contents of the hill, by mean heights, would only show 310,000 cubic yards—that is to say, there would be a difference of 22,000 cubic yards against the contractor, the consequence of which had been, that the person contracting to cut down such a hill, at so much per yard, would lose, from his bad method of calculation, above £1,000. Another method was also in use—calculating by the mean area; which system, instead of 332,000 cubic yards, would show 376,000 cubic yards, being an excess in favor of the contractor of 44,000 cubic yards. Many contractors had realised large fortunes by mean areas, and sustained serious losses by mean heights. Having thus shown the erroneous methods of calculation in use, he then, at some length, explained the prismoidal formula, accompanying his instructions with many diagrams, without which any attempt at explanation on our part would be useless. The learned professor concluded his lecture by strongly recommending a close study of mathematics to the junior (all) students, as the greatest assistant to the labors of the civil engineer.

[From the New York Tribune.]

MR. LYELL'S FIFTH LECTURE ON GEOLOGY.—ORIGIN OF COAL.

In speaking of the different strata of which the earth's crust is composed—those at least which contain organic remains—I spoke of them as so many volumes of history—as so many monuments of the ancient states of the globe; and of their different structures as being so many leaves of these volumes. All that I can do in this short course of lectures is to take down at random, first one and then another of these volumes and endeavor not to give you any idea of the contents of the whole, but just to express something of the method employed in the attempt to decypher these ancient memorials of the earth's history. Now the volume which I intend to take down to-night is that which we term the *coal formation*; and I shall speak of it only so far as to show the relative position, and the state of the different periods when they were deposited beneath the water.

Now when I term this formation *coal*, I merely mean this assemblage of strata which rests on the older sandstone, and in which is found that invaluable fuel we call coal; and although the quantity in which it is contained is very small in comparison with the bulk and volume of the other strata, there is still great interest and importance attached to it. We see that in going from the highest to the lowest beds yet discovered the coal occupies quite an ancient position—one indicating a formation low down in the sea—as we have above it the most modern formations. We have first the post-pliocene, then the tertiary formation, then the chalk, which is made up of calcarious, matter formed mostly, at least in Europe, from decomposed shells and coals and of those green marls which are found in New Jersey, and are of such extensive use in agriculture; then we have the jura limestone or oolite, in which also are masses of coral like the common coral reefs: below this are two other groups, of which I shall not speak at present, and lastly we come down to the carboniferous or coal-bearing stratum which rests upon the thick sandstone beds, or the limestone containing corals and which like every other formation contains species of animals, shells and plants of different species, from these immediately antecedent or following. Below this again, we see limestone and shale, which enter most largely into the structure of the rocks of the State of New York and which abound in fossils.

Now a great change must have been experienced before the coal period, when the fossils were deposited. I am indebted to Mr. Sopwith, an eminent civil engineer, for copies of some models prepared by him of those sections, which are faithful and accurate representations of actual localities, as has been fully verified by Dr. Buckland and myself in examinations which we made last spring. The different strata of sand stone, shale and conglomerate, of which the carboniferous formation is composed, are here represented. The sections represent facts ascertained in cutting perpendicularly through the Newcastle coal district. They are not hypothetical, but are founded upon exact measurement. In one of these sections you see the dip of the beds is at an angle of 20°, while the slope of the valley is 40°. In the other, the dip is 50°, and the slope of the valley in the same direction is 20°. In these two cases, therefore, the relation of the slope of the valley and the dip of the beds is reversed. In both cases, also, the slope of the valley and dip of the beds are to the south. To those who are not acquainted with these technical terms, I may say, that the deviation from a horizontal plane of the beds is called the *dip;* while the *strike*, as it is called, is the extension of the strata in a direction at right angles to the dip. In this case, as the dip is to the south, the strike must be from east to west. The flexures of the valleys depend on their inclination relatively to the dip: and these two sections cut through beds of coal and shale and sandstone—the shale being indurated clay—are illustrations of cases in which the two strata come up the surface according to the various relations of the slope of the valley and the dip of the bed. It is a rule among miners that when the dip of the beds is less steep than the slope of the valley in the same direction, then the V's as they are termed, with point upwards, those formed by newer beds appearing in a superior position and extending higher up the valley. But when the case is reversed, and the dip of the beds is steeper than the slope of the valley, then the V's point downwards and those formed of the older beds appear uppermost. These rules may often be of great practical service in many cases. For example, suppose a miner first to begin his operations in one valley with the structure of which he is familiar. If he should sink his shaft through the formation above, he would come to the coal which is below. But suppose one unacquainted with these rules which I have been explaining to go to another valley; and in England he might easily go to such a valley, for these cases, as I said, are not hypothetical. He might, continuing along the same side of the hills as he had seen in the other valleys, where he observed the same *out-cropping*, as it is termed, of the coal seams, suppose, reasoning from his former experience, that he might begin his workings in the bed at the higher part of the valley with the expectation of coming down to the other bed. But he would be disappointed, as you will readily see, by observing that the uppermost bed is the lowest down in the valley, and the lower bed is the highest up. This you can easily trace with your eye upon the sections. An acquaintance with these rules and their application is of the greatest importance to those speculating in mining transactions. In the coal field of Pennsylvania, to which I shall presently allude, near Pottsville, I saw an exemplification this year of the two cases alluded to —when in the coal of the same valleys the V's in some cases pointed one way, and in the others in the opposite—the dip and slope being both towards the south. There is nothing more singular or which has struck me so forcibly in respect to the coal fields of this country, as their close resemblance to those of the north of Europe, and of England in particular. I have travelled on the north side of the Alps towards the south, and have been astonished to find minerals of fossil of entirely distinct genera from those met with in the Pyrenees. Nor have the chains of mountains any thing to do with this remarkable change—for the beds were formed at the bottom of the sea before the mountains existed. Observing this great change, then, in the short passage of a few hundred miles, it seems to me not surprising, that in passing at the distance of three or four thousand miles, from England to the Apalachian chain in Virginia, we should find the coal measures the same as those we left behind, represented in the red sandstone, and containing white grit and slaty shales, and clays not slaty, and beds of conglomerate containing quartz pebbles.

It is generally admitted by geologists that *all that fuel which we call coal is of vegetable origin.* If there has been any dispute with regard to this, it was settled when a portion of the Newcastle coal some years ago was submitted to a microscopic examination. After cutting off a slice so thin that it should transmit light, it was found that, in many parts of the pure and solid coal in which geologists had no suspicion that they should be able to detect any vegetable structure, not only were the annular rings of the growth of several kinds of trees beautifully distinct, but even the medullary rays, and, what is still more remarkable, in some cases even the spiral vessels could be discerned. But besides these proofs from observing a vegetable structure in the coal itself, there has been found in the shales accompanying it, fern leaves and branches as well as other plants, and when we find the trunks of trees and the bark converted into this same kind of coal as we find in the great solid beds, no one will dispute the strong evidence in favor of the vegetable origin of this coal. If we find a circumference of bark surrounding a cylindrical mass of sand, we know that it has been a hollow tree filled up with sand, nor can there be any doubt that the coal is formed of vegetable matter. No less than three hundred species of plants have been well determined by botanists, some of whom have devoted a great part of their lives to this study. From this it is to be inferred that the carboniferous formation of Europe and America is made up of comparatively recent plants. I will allude to three or four of the most peculiar facts that lead to this conclusion.

In the first place the boughs and leaves of ferns are the most frequently and strikingly met in America as well as in Europe. So perfectly have they been preserved that there can be no doubt that they are really ferns; and in some cases even their inflorescence has been preserved at the back of the leaves. Where we have not the flowers and prints remaining, we have found it possible to distinguish the different species of fossils and ancient ferns by attending to the veining of the leaves. At least one hundred species are determined in this way. The most numerous of these vegetable veinings are those which have been called *Sagillaria*, or tree ferns. Their stems are found to be fluted vertically, and in the flutings are little stars, as it were, each of which indicates the place where the leaf was attached; and it is evident, as M. Adolphe Brongniart has shown, that they are recent tree ferns. One argument for believing this is that, although the bark of these trees is so well marked that forty-two species have been described, yet there is never found any leaf attached; while we have in the same beds loose leaves in abundance which have no trunks. The natural inference is that they must have belonged to the aborescent ferns; as for instance, the section *Cauloptoris* is admitted by all to have belonged to this species. The fact is also important because the tree ferns and especially the *Cauloptoris* are now known to be exclusively the inhabitants of a warm and humid climate;—much more hot and moist than in those parts of the globe where coal now abounds. For we find coal not only in England and Nova Scotia, but as far north as Melville's island and Baffin's bay, in a climate where the growth of such fern plants is dwarfish and stinted. It is evident that when these vegetables existed there must have been a warmer and probably a more equable climate than now even in warmer latitudes.

[To be concluded in our next.]

Academy of Sciences.—*Sitting of February* 21.—A letter was read from the Academy of Sciences and manufacturers at Lille, requesting the Academy to support an application to Government against the suppression of the beet-root sugar manufactories. M. Arago, the perpetual secretary, recommended that the Academy should not comply with this request, since it was of a political nature, and his advice was adopted. Some curious experiments were mentioned as having been lately made by Captain Bailly, of the engineers, on an Artesian well at Lille, which had exhibited some remarkable phenomena of intermission in the discharge of the water. M. Bailly had proved that these intermissions corresponded with the tides of Dunkirk. A commission was named to report on the subject. M. Arago read a communication from Mr. Nasmyth, an English engineer, that it had been observed on several lines of railroads in England that the rails never rusted when they were traversed by wagons going always in the same direction; but that when they served for wagons going in two directions, as in the case of a single line of rails, they became rusted very soon. M. Matteucci announced that he had succeeded in reproducing the celebrated experiment of Galvani, by putting the nerves and the muscles of a living animal in communication with each other. This instantly produced an electric current, susceptible of being multiplied by an arrangement similar to the voltaic pile; and he had thus produced deviation in a galvanemeter, amounting to 25 degrees. M. Galle, of Berlin, was stated, by M. Arago, to have observed the comet of Encke, within a short period, and had found it differ by only one minute from the place assigned.—*Paris paper*

Exportation of Machinery.—The select committee of the House of Commons, lately appointed to inquire into the operation of the existing laws affecting the exportation of machinery, have just published their second report to the House. This report is much too long to allow of any detailed reference to it, but we subjoin the final recommendation of the committee on the subject, which is to the following effect, viz.:—"That, considering that machinery is the only product of British industry upon the export of which restraints are placed, the committee recommend that the law prohibiting the export of machinery should be repealed, and the trade of machine making be placed upon the same footing as other departments of British industry."

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[For the American Railroad Journal, and Mechanics' Magazine.]

PRESERVATION OF TIMBER.

Mr. Editor: In your Journal of the 15th instant, which, being from home, I did not receive until just now, is an article, pp. 234—235, adverting to the process of curing timber, etc., by the sulphates of iron and copper, and admonishing the public against "the too hasty adoption" of it.

I am unwilling to impute to "Z." any extension of motive beyond that for which he would be credited; and, being not only willing but desirous that the fullest and justest knowledge may be possessed of the character and value of the process, I will join him in contributing, without reserve, all in my power to that object. I refer the public and him, therefore, to another article on the same subject, happily, though accidentally published in the same number, pp. 248—249, containing an "Extract of a letter from James Archbald, Esq., etc." To M. Boucherie's experiments on the pulp of beet this "extract" furnishes the best, and, as I deem it, a sufficient reply. I willingly leave them to be balanced against each other.

And, for the "wooden pavement in 6th street," I invite attention to the following certificate of the city commissioner, Mr. Wallace, and the city carpenter, Mr. Thorn, by whom that matter is represented both more favorably and more correctly:

"To correct an erroneous and injurious impression, entertained by many, relative to the wooden pavement in 6th street, between Chesnut and George streets,—we certify that only a part of it was prepared according to Dr. Earle's process with the sulphates of iron and copper, the remainder being prepared with lime; that the former is still perfectly sound, except six or eight blocks, which, from examination, appear to have been originally defective, (the entire wood of that pavement is of hemlock that had been long kept and was very much injured in its quality;) and that the remainder of it, (prepared with lime) up to the line where the former ceases, is so far decayed that at this time, it almost requires renewal. The contrast between the two portions of that pavement is, in short, of the most obvious and conclusive kind.

"T. K. Wallace, *City Commissioner.*
"Enoch Thorn, *City Carpenter.*"

"Philadelphia, *April* 25, 1842."

It is a pity "Z.," who would seem to mean well, was so easy of "belief" in stating as facts what very little trouble would have informed him were not such. By such carelessness or indifference, he should remember that he may mislead the public, and injuriously affect the interests he professes a desire to protect. But it is hoped that if he should have at his command any better and more-to-be-relied-on admonition on this subject he may not withhold it.

E. Earle.

Philadelphia, *April* 25, 1842.

[For the American Railroad Journal and Mechanics' Magazine.]

JUDICIOUS TARIFF OF TOLLS AND FREIGHT.

Mr. Ellet, with a praiseworthy zeal for the enlightenment of the public, published some two or three years ago an "*Essay on the Laws of Trade,*" but which we rather fear, from the formulæ in which it is expressed, has been read but little beyond his own professional brethren, and hard for some of them to understand. Few, in these days, are found with the patience, if they have the requisite knowledge, to solve a problem in algebra, and it is very rare that that science as well as Greek are not driven from the mind very soon after it becomes occupied with the cares and duties of active life. It used to be that the longest way about was the shortest way home in true knowledge, but people have of late been so spoiled by the many "short cuts" to arrive at it, that anything else is generally neglected.

The subject of a judicious tariff of tolls and freight on transportation is a highly important one; and although they ultimately adjust themselves, yet it would be well to have them systemized as proposed by Mr. Ellet. It is generally assumed in this country, that one cent per ton per mile for toll, and the same for freight, is the cost, including a fair profit for the transportation on a canal, reference not being had to capacity, lockage, etc.; and above all that the cost must depend on the amount of tonnage which passes over it. With the majority canals and railways are all alike. It is rarely adverted to that the sparseness of our population, with its disposition and facility to scatter, rarely concentrates a consumption sufficient to make business equal to the support of a costly improvement not situated in a mineral district, from which alone a large tonnage can be reasonably anticipated.

It is not, however, the present trade which alone should induce an improvement,—the object should also be, and the effect generally is, to increase the old and beget new trade,—and it is well that there is always found enterprise and intelligence enough in a community to invest their means without a calculation of the immediate gain, and Mr. Ellet clearly shows that the indirect compensation from these undertakings is often more than the direct dividends. It is not, however, to be denied that there has been great recklessness among us in carrying them far beyond any probable consumption and consequent business to sustain them.

The following extracts are conveyed in clear terms and gives much of the cream of the essay, in setting forth the importance of a judicious tariff, by which is meant a due attention to the round of interest mutually promoted by a proper adjustment of it. These extracts are particularly worthy of being read and understood by the farming interest, which shares so largely in the advantages of both canals and railways:

"Let us suppose for a moment, that we had determined, from a careful calculation, the charge which our equations would indicate to be the most advantageous for the dividend; and that the tariff for the coal and ore, iron, plaster and wheat, had been regulated with a view to the greatest possible profit under the distribution assumed for the tonnage. On further investigation, we would discover causes for a modification, and, very generally, for a reduction of the charges established.

"We would observe, for instance, that the toll on plaster might give the greatest revenue for the year in question, and for that article taken separately; but that if the charge on each ton were reduced, it would be carried a greater distance on the line, and a greater distance into the interior, to the right and left; that some farmers who had not been able to obtain it before, could now enrich their lands by its use, and others who had previously used but a small amount, could now increase their purchases; and that, although a slight loss would, perhaps, be experienced in the immediate toll, the company would be indirectly remunerated by the augmented crop of wheat springing from its application.

"The increased supply of wheat would not only pay them again in toll, but would be productive of an increased demand for water for its manufacture. The water would remunerate the company again in rents, and perhaps in the further manufacture of articles on which toll could be levied.

"The additional wheat would produce additional straw and chaff and bran. The straw would go to the further enrichment of the soil, and the re-production of increased crops; the bran to the production of stock, and the stock again to the improvement of the soil. The tanneries are brought into operation by the same cause, and the bark that supplies them increases the toll. Barrels are needed for the flour, tolls are received from the barrels, and water power is purchased for the production of the staves.

"The operation of the same influence,—the reduction of toll on manure,—might be traced in other directions, and to other varieties of produce, and would result in showing the infinite modes in which the income of the company might be augmented by a diminution of its immediate revenue on one item.

"If we trace the passage of the ore from the mine to its numerous applications to the mechanic arts, we will find it not less interesting, and the profits of the improvement not less involved in its various transformations. A reduction of the toll on this article will increase its consumption at the furnace located on the borders of the canal; the proprietor of the furnace pays for the water employed for the blast; the product of the furnace augments the revenue in its transportation to the rolling-mill or trip-hammer, and a new demand for water is created at the forge.

"The activity of the operations at the collieries is augmented to furnish the fuel necessary for the conversion of the ore into metal, or the forests are levelled for the purpose, and new tracts of land thence brought under tillage. The increased operations at the various establishments through which the mineral passes, creates new demand for the machinery needed for their duties, and the talents of the artisan and the labor of the mechanic are brought into requisition.

"The proprietors of the numerous establishments called into existence by this policy, soon find that their interests will be promoted by an extension of their business; and the power thus created, and the materials that are furnished, for the supply of a limited local demand, become shortly applied to the competition for foreign markets.

"The population is increased, and consequently the products of the labor and the wants of society, are at the same time augmented.

"Such effects are in the first place brought about by the improvement itself, in reducing the cost of transportation, and offering facilities for the profitable application of capital and labor; and analogous results spring from each successive reduction of the charges on the line.

"And so far, they are to be regarded as arguments in favor of keeping always within the limit assigned by the geometrical principles which have controlled our investigations.

"Independently of these considerations, there are others which militate in favor of the same policy, growing out of the constitution of the corporations by which the great lines of improvement of the country are generally constructed.

"Such works are rarely, if ever, undertaken exclusively as objects of immediate speculation. Capital is too valuable here to be invested in enterprises which can at best be expected to return but a moderate interest, and that at a day so distant, that the capitalist looks upon his subscription rather as the property of his heirs than himself And in consequence, investments are seldom made in such objects with a view to the immediate profitableness of the venture as an interest paying fund.

"The stock is held by the individvals whose business is to be enhanced, or whose vacant grounds are to be brought into market, by the growth of the city at the outlet of the improvement, or at the points which are to receive peculiar benefit from the trade of the region through which it is conducted; by the banks that are connected in business with the corporation, and whose operations are to be increased by the general expansion of trade consequent on its ultimate success; by the sea ports at which they terminate, whose existence as cities depends on the successful accomplishment of the design, and whose interest in the project, independently of their interest as stockholders, is directly as the trade which they owe to its completion; and finally, by the commonwealth itself, whose interest as a partial proprietor is of the same character, to the extent to which it reaches, as if it were the sole possessor of the work.

"The interest of the proprietors of the improvement, apart from that which they possess in the value of the stock, is of various descriptions, and of a character to which it is difficult to assign a value; but it is, to express the idea in mathematical language, a function of the charges upon the line; and consequently, must be regarded in arranging the tariff of toll. For, if after the most advantageous charge in reference to the location and character of the trade is determined, it be found that a certain reduction would produce a certain increase of trade, and that any stockholder would gain more by the increase of the profits of his business due to the change, than he would lose by the diminution of his dividend; then, so far at least as that individual is concerned, it would be proper to make the reduction. And considering the constitution of such corporations, it appears to be probable that there are few connected with them whose interests would not be individually affected in this way."

Considerable modifications have of late been made in the charges on railways since the opening of the Great Western road from Boston to Albany and the Philadelphia and Pottsville railway. The reductions made on these lines astonish the advocates of canals, and are a total overthrow to the doctrine so long tried to be sustained that railways were unsuited for *heavy freight* as it is called, as if there could be a difference, when the weight in contact with *any one* point of the road is made the same, whether passengers, feathers, coal or iron, except indeed, in favor of the latter as the more compact load. We are glad to perceive that other roads, such as the Baltimore and Philadelphia, are coming into the low rate system, having recently reduced their freight to $8 per ton. The Camden and Amboy now alone maintain disproportionably high rates.

Rates of freight on various lines.

New York to Boston, steamboat and railway, 230 *miles,*—

$5 50 to $7 per ton of 2000 lbs., for groceries and merchandize generally.

Albany to Boston, Western railway, 200 *miles,*—

1st class, $9 per ton of 2000 lbs., comprising fancy goods, furs, indigo, ivory, jewelry, medicines, dry goods, hardware, teas, spices, wax, etc., etc.

2d class, $6 50 per ton of 2000 lbs., comprising bacon, provisions, sheet and rod iron, wines, hemp, hides, coffee, pepper, etc.

3d class, $5 per ton of 2000 lbs., bar iron, cotton, cordage, tar, sugar, tobacco, rice, molasses, wool, spirits, etc.

4th class, $4 per ton of 2000 lbs., pot and pearl ashes, pig iron, lead, lime, plaster, timber, fish, coal, bricks, salt, flour (32 cents per barrel.)

New York to Philadelphia, Camden and Amboy railway, 90 *miles,*—

$15 to $20 per ton, on merchandize generally.

Philadelphia to Baltimore, Philadelphia and Baltimore railway, 93 *miles,*—

$8 per ton on merchandize generally.

Philadelphia to Pottsville, Philadelphia and Pottsville railway, 94 *miles,*—

$4 25 and $5 25 per ton, on groceries and merchandize generally.

$1 50 to $3 per ton, on coal and other heavy goods.

[For the American Railroad Journal and Mechanics' Magazine.]

ENGINEER'S OFFICE, SUSQUEHANNA DIVISION,
NEW YORK AND ERIE RAILROAD,
ELMIRA, *April* 14, 1842.

MR. EDITOR: Since the publication of my communication on "*railroad piling*" in your Journal of March 1st, I have received many letters from engineers in different parts of the Union, requesting me to continue the subject in your valuable Journal, as they feel a deep interest in this *new* and *important improvement* in railroad construction, and are very desirous of knowing the method adopted on this division, to ascertain if the timber used was of suitable quality and dimensions, and the workmanship properly done. In compliance therefore with the wishes of those who have expressed a desire for "further information relative to our experience in railroad piling," and your own request, I send you the following additional extracts from my testimony upon this subject, when before the State Investigating Committee, in October last, and will cheerfully give any further statements that engineers or others interested in the construction of railroads may desire, and thereby contribute my mite towards the spreading of *practical knowledge and experience* in railroad construction throughout the country.

With respect, I remain truly yours,

C. B. STUART,
Chief Engineer Susquehannan Division,
New York and Erie railroad.

Extract from the deposition of C. B. Stuart, Civil Engineer, before the State Investigating Committee, at Elmira, October 30, 1841.

" *Question* 10, *by the chairman.*—What is the system adopted, if any, to ascertain whether the timber and piles conform to the specifications adopted by the company, and whether the piles are properly driven?

" *Answer.*—An inspector of pile road is stationed at each steam pile driver, whose duty it is to be on the work *constantly,* while the machine is in operation, and to see that every pile is driven to a firm foundation, and that they conform to the central line staked out by the engineer, and are sawed off to the grade line, as indicated on the profile by stakes given by the engineer. In case the piles are driven out of the line, it is his duty to direct the foreman or superintendent of the machine to drive other piles along side of them in the proper place. If the piles first driven are not long enough to reach the solid bottom, a second pile is placed on the top of the first, well secured by an oak tree-nail or iron rod at the joint; the second pile is then driven at least *five* feet below the surface of the ground, and until the first pile reaches the solid bottom. It is required that the last blow of the pile-ram, weighing 1200 pounds and over, and falling through a space of 30 feet, shall not settle the pile more than two inches; the force of which below is considered equal to the pressure of 150 tons. When the second pile will not drive to the depth of *five* feet below the surface of the ground,—the first pile having reached the solid bottom,—a third pile is used, of the requisite length to reach from the grade to the solid bottom, and driven in their stead. On the certificate of the inspector, that any sub-contractor, foreman or superintendent neglects or refused to do his work in a proper manner, and to his satisfaction and acceptance, I have the power to certify to the commissioner, such sub-contractor, foreman or superintendent, and upon such certificate, the commissioner has power to have him discharged from the service of the contractors, and he cannot again be employed in such capacity. In case extra piles are required to be driven, owing to the unskillful manner of driving the first, the contractors are required to pay for the extra piles so used. The inspector makes weekly reports to me, at my office in Elmira, by mail, stating the number of piles driven during the past week, the length of the piles so driven, and the height that they are sawed off from the surface of the ground; and also the quantity of piles delivered for the use of the machine under his charge, by the several contractors for pile timber. At the end of each month, these reports are compared with the returns and certificates of the resident engineer, in the employ of the contractors; if the amounts correspond, the voucher is made out, and certified to by me as correct; and in case the two returns vary in quantity, the work is measured by my principal assistant engineer, and the true quantity returned by them; and upon their return my certificate is based. There is an inspector for superstructure timber in each county through which the road passed on this division, whose duty it is to inspect all the timber delivered for the superstructure of the road, according to the contract and specifications for the same; and to see that it is properly piled up, true and even, so as to protect it from springing or warping. These inspectors make weekly reports, directed to me at Elmira, by mail, of the quantity delivered by different contractors, upon which reports, the monthly vouchers are based and certified by me. The inspectors of bridges make weekly reports of the amount of timber delivered for the several bridges under their charge,—by whom delivered, together with the quantity of timber framed and put together for the foundations and superstructure of the bridges, and the number of piles driven for their foundations. The bridge inspectors have the same power over the foremen of the machines and mechanics under their direction, as the pile road inspectors have, as before stated.

"*Question* 11.—How many inspectors of piled road, of bridges and of superstructure timber, are there in the employment of the company on this division, and what are their wages respectively?

"*Answer.*—Eight inspectors of piles and piled road, being due to each steam pile-driver, the wages of these inspectors are $40 per month, with one exception, which is $50. There are four inspectors of bridges, each having charge of a pile machine and a party of mechanics engaged in the construction of bridges. The wages of these inspectors are $60 per month each, with one exception which is $52. There are three inspectors of superstructure timber, at $3 per day, including travelling expenses, each of them having charge of a division of nearly forty miles in length.

"*Question* 36.—Do you consider it necessary to have inspectors of piles and piled road on this division; and do the depth that the piles are driven vary materially within short distances on the same general surface of the ground, owing to the sub-soils?

"*Answer.*—I consider it absolutely necessary for the stability of the road, to have competent inspectors *constantly* in attendance while the piling machine is in operation, to see that every pile is driven to a solid bottom, and also to see that all the piles used in the work are of proper *size* and *length*, and of *perfect soundness.*

"It frequently occurs that two piles driven at the same time on opposite sides of the machine, of the same diameter and length, will vary from one to three feet in the depth they can be driven by hammers of the same weight, owing in some instances to the change in the sub-soil, in others to the pile coming in contact with a large stone a few feet below the surface. On the same general surface of the country, where, to all appearance, the character of the soil was uniform, and within fifty feet on the road, I have seen piles vary from ten to fifteen feet in the depth they would penetrate the soil, which makes it frequently necessary to order longer piles, than the previous soundings with an iron rod (made for that purpose) indicated as necessary.

"No one, unless in *constant* attendance, could know that the piles were driven to the solid bottom, as it is of common occurrence to find a bed of quick sand, some five or ten feet below the surface of the ground, and when the pile has penetrated through this strata of quick sand, to find a hard bottom of gravel or clay; unless their lower bed of solid earth is reached by the pile, the stability of the road cannot be depended upon; any deficiency on this point could not be detected until after the road was completed, unless an *inspector was constantly present.* Indeed, so necessary do I consider the constant supervision of an inspector to attend the machines, that I have, in my written orders to them, (a copy of which is hereunto annexed, marked F.) required their presence during the *whole time the machine is in operation;* and for a violation of this duty, have not hesitated to discharge them from the service of the company. From the first commencement of pile driving on this division, in May, 1840, till the spring of 1841, I had no piled road inspectors, (whose duty it was to attend constantly at the machines,) but found by experience, that the interest of the company, as it regarded the permanency of the road, required their appointment. I think the character of the work that has been done this year on the piled road, since the appointment of inspectors, is at least twenty per cent. better than that done last year, by the same contractors.

"It is the duty also of these inspectors to inspect the piles delivered for the machines under their charge, respectively; which timber is furnished by the company, and *not* by the contractors who drive the piles.

"The engineers who stake out the work for the pile machines, are employed by the contractors that do the piling and grading, and have no charge of the timber delivered for piles, for the use of the machines. The piles are driven by sub-contractors, in the employ of the contractors, (Manrow and Higinbotham) and are paid by them certain prices *per mile*, and not by the lineal foot of pile.

"On the Syracuse and Utica railroad, where the piles for pile-road were driven by persons employed by that company by the day, (and who of course had no interest in slighting the work,) and where the work was daily inspected by the Engineer's in the employ of the company, it has been discovered, since the completion of that road, that many of the piles were *not* driven to a firm or solid foundation, which neglect causes much trouble and expense, in keeping such portions of the road in good adjustment; this imperfect work was mainly the result of a competition or emulation between the superintendents of the several machines, each one endeavouring to recommend himself to the fovorable notice of the company, by doing the largest amount of work in a given time. This could have been prevented, only by the *constant* attendance of a competent inspector, during the progress of the work.

"I do not hesitate to say, that all the irregularities found on the piled-road of that work, are owing to the piles not having been driven to a solid foundation, for the want of a sufficient number of blows by the pile-hammer. Thus you will see the necessity of having a competent inspector in attendance at each machine, to guard against these defects; and more especially is this required where piling is *not* done by the *day*, but by *contract*.

"*Question* 37, *by the Chairman*.—How much does the employment of inspectors for each machine, increase the expense of constructing the piled road, per mile?

"*Answer*.—Not to *exceed* $20, in addition to the expense that would be necessarily incurred, for the inspection of pile timber, and testing of the measurements that are made by the contractors engineers, of the quantity of work done each month; and which duties are now performed by the inspectors; these measurements are the more necessary, as the amount paid the contractors for the work varies with the length of the piles driven, and the heighth that they are sawed off above the surface of the ground."

(F.)

HEAD QUARTERS' ENGINEER DEPARTMENT,
SUSQUEHANNAH DIVISION, N. Y. & E. R. R.
OWEGO, *May*, 1841.

Orders to Inspectors.

"1st. It shall be the duty of each and every inspector employed to inspsct the mechanical work on the Susquehannah Division, to see that the workmanship is done in accordance with the printed specificatiens and plans furnished him, (unless otherwise directed by the Engineer,) and to report in writing, to the Chief Engineer of the Division, or in his absence to one of his principal Assistant Engineers, the name of any person or persons in the employ of the contractors, either as sub-contractor, foreman or laborer, who shall neglect to perform their duty promptly and faithfully, or construct the work to the entire satisfaction of the inspector.

"2d. The inspector having charge of the driving of piles for the piled road or for the foundations of bridges, will be required to attend personally to the work during the time the machine is in operation, and to see that the piles are driven to a solid and firm foundation, and that the requisite timber is punctually delivered according to the contracts for the same, inspected and properly marked before being used in the work, and no timber to be used in the work unless accepted and marked by the inspector.

"In case of the failure of the timber contractors to deliver the timber as fast as required on their contracts, the inspector shall report the same in writing to the Chief Engineer, directed to his office at Owego, stating the quantity of timber required on the contract, to complete the same, together with the cause of such failure, provided the same can be assertained.

"3d. Each inspector is required to report any deficiency that may occur in the delivering of piles for the machines at least one week previous to the time they shall be required for use.

"4th. It shall be the duty of the inspector to see that the piles are butted evenly, on the butt or head, and sharpened with a true taper at the point. Piles one foot and under in diameter at the butt, to be sharpened not less than two and one half feet from the point, and those over one foot in diameter, not less than three feet.

"5th. It shall be the duty of each inspector to forward by mail, on the Saturday of each week to the Chief Engineer at Owego, a statement, showing the time he has been employed during the week in the company's service, and the kind of duty performed each day during that time, the amount of timber inspected by him, and the amount and kind of work that he has inspected and accepted, together with the number of piles driven by each machine under his charge, and to furnish a copy of this statement to the Assistant Engineer having charge of the section on which the said Inspector is employed.

"6th. Any neglect on the part of either of the inspectors, unless prevented by sickness, to perform these orders, will be considered good and sufficient reason for his dismissal from the service of the company.

"By order of

"C. B. STUART,

"*Chief Engineer Susquehannah Division,*

"*New York and Erie railroad.*"

[For the American Railroad Journal and Mechanics' Magazine.]

SOME REMARKS ON THE MANUFACTURE OF BAR IRON IN NORTHERN NEW YORK. *By* W. R. CASEY, *Civil Engineer.*

[Concluded from page 263.]

It has been frequently remarked by Geologists—by Dr. Lyell among the rest—that the Geological Survey of New York has been the means of saving large sums to those who were endeavoring to discover coal in various districts in which that survey has shown, that coal cannot exist. The rocks which always underlie the coal formation are here found on the surface. A little attention to the published reports of the Geologists would, in the year 1840, have saved the State about $10,000 in the survey of the Northern railroad. The success of that road was based on its mineral resources, yet one of the lines runs through a country in which, practically speaking, there can be no mineral resources. The formation is principally Potsdam Sandstone, as Professor Emmons observes, "one of the most barren rocks in the State."

This, as regards mineral wealth, barren route—had been surveyed by Mr. Hutchinson for a canal in 1825, and by Mr. Johnson for a railroad in 1838. The features of the country were therefore well known; and, as the Commissioners of the Survey themselves assert, (Doc. 43. 1841 p. 13.) that "the principal sources of wealth in these counties are to be looked for in their immense deposites of iron ore, and of other valuable mineral substances," it would not appear unreasonable to expect that some enquiries should have been made, as to whether any really valuable mineral substances were found in the neighborhood of the several routes. This information would have been given by the State Geologist in a single hour and, as already observed, the people would have saved about $10,000, by avoiding a re-survey of a route which itself avoided "the principal sources of wealth in these counties." These remarks are considered useful as showing the really practical results and great importance of Geological Surveys, as well as their intimate connection with Civil Engineering in other matters than deep cuts and tunnels.

The most valuable deposites of iron ore are found in Clinton and Essex counties. The greatest deposite is found at Adirondack in Essex, the principal manufactories are in Clinton, and are supplied from the Arnold and other veins in the southern part of the county. A considerable quantity of pig iron is made at Port Henry in Essex county, but the manufacture of bar-iron is in a great degree confined to the neighborhood of the "Arnold ore" which is worked without separation. This ore is found within 2 miles of the Au Sable river, which divides the counties of Clinton and Essex, has been worked to a depth of 250 feet, sells at the mine at from $4 to $5 per ton, and is hauled, over a hilly country, through deep sand, from 2 to 20 miles to the various forges on the Au Sable and its tributaries and on the Saranac. In proof of the high value set on this ore, the following statement is given on the authority of the President of the Peru iron company. That company own a mine within half a mile of their works—the ore of which is equal to any in the county, except the Arnold ore—yet they find it more to their interest to pay $4 per ton for the latter, hauling it 4 times as far, as to work their own ore which requires separating. They consider their own mine valuable, principally because it renders them independent of the Arnold vein should the proprietors of the latter be too exacting. The ore from that vein is raised from a depth of about 80 feet in general and, should the hill in which it is found be tunnelled near its base, the ore might be afforded at a much lower rate, when it would entirely supersede the ores which require separating and which are still used to a limited extent. No less than 12 veins are found within a distance of a few miles, but one alone is sufficiently pure to work in the forge as it comes from the mine. This remark applies to veins sufficiently large to be worked and not to small seams of pure ore which are occasionally met with. Practically speaking therefore, the manufactories of bar-iron in the counties of Clinton and Essex are supplied from the Arnold and adjacent veins, in or near the town of Au Sable.

The forges are nearly all within 15 miles of these mines, on different streams. There are in all 77 forge-fires—14 on the Saranac, the remainder on the Great and Little Sable and tributaries. Six of these forge-fires on the Saranac draw a part of their supply, the others are exclusively supplied from the mines of Au Sable.

The expense of hauling ore 15 miles has induced the proprietors of the former to use in part a poor ore found in their immediate neighborhood. Great skill has necessarily been acquired in finding veins of iron ore, the country has been examined again and again, yet the really valuable ores of Clinton county—though inexhaustible in quantity—would be represented by a speck on the map of New York.

The quantity of bar iron produced in 1841 was 5,500 tons, the greater part of which was cut into nails. This is nearly equal to the total export from England 40 years ago and is about one tenth the quantity of bar iron produced in the State as given in the *census;* it is probably much nearer one half—perhaps considerably more. The census must include blooms from New Jersey, etc., rolled in this State and perhaps bar-iron made from Scotch and American pig. Little iron has ever been made in the river counties, still less in the central and southern, and, of the 8 northern counties two only, Clinton and Essex, can be said to have any claims; the other 6 (Franklin, St. Lawrence, Jefferson, Lewis, Hamilton and Herkimer,) turning out only a portion of the small quantity of bar iron and nails required for their own use. Some of these counties as well as the State of Vermont are in part supplied from the Au Sable forges, besides which the latter takes considerable quantities of ore from Port Henry in Essex county to be worked on the eastern shore of Lake Champlain. Again, the Legislature has directed a commissioner to ascertain whether the convicts could not be advantageously employed in mining iron ore, and he was directed to inspect the mines of the north—no other part of the State even putting in a claim. This could not have well taken place, if the north only made one tenth of the bar iron produced in the State. Indeed if any district had produced one fifth of the yield of the Au Sable mines, the north, with its slight population, would not have been considered the only section entitled to notice as an iron region. These circumstances, confirmed by the results of numerous enquiries, lead the writer to believe that the total quantity of bar-iron made from the ore in New York in 1841, fell short of 10,000 tons—an amount not exceeding the capacity of the forges of Clinton and Essex which, owing to the depressed state of the trade, are not nearly worked to their capacity. The greater part of these forges have sprung into existence within a few years, the trade is yet in its infancy and, with any thing like stability in the business of the country, would rapidly increase. The quality of the iron is excellent, very tough and soft.

The ore is the magnetic oxide of iron and is found in veins in a reddish granite, dipping at an angle of 70 to 80 degrees.

The manufacture of bar-iron is confined principally to the valley of the Au Sable, because in that neighborhood alone are ore and water power found together within a reasonable distance of Lake Champlain. These advantages will also do much to maintain its present preeminence, though, as roads are made into the interior, other districts will be reached where rich deposites of iron ore exist. By far the most important of these, is the wonderful deposite of the purest ore at Adirondack in the town of Newcombe in Essex county. In referring to "other collections of magnetic oxide of iron, in this and the neighboring counties," Professor Emmons remarks, that, "though they are important and have been successfully worked, still, in comparison of quantity with those of McIntyre, (the iron works at Adirondack) they are only as the spatterings from the great cauldron in which these ores have been formed." (Assem. doc. 50. 1840, p. 298.) Again, (p. 296.) "Probably no portion of the world can vie with McIntyre in its ores of irons; even the far famed iron mountains of Missouri are eclipsed by the rich ores of Essex county, New York; and if not in quantity, at least in quality," etc. One of these veins is 2½ miles long and 500 feet wide—another is above 3000 feet long and 700 feet wide. The former is elevated 2 to 600 feet above the lake and is litterally a mountain of ore. Dr. Beck gives the following analysis (ibid. p. 65.) "Protoxide and peroxide of iron 92.15, earthy matter principally silica 7.85. Proportion of metallic iron about 66, in 100 of the ore." The experiments, by Mr. Clay's process, alluded to in the first part of these remarks were made with this ore. The forge has not been worked for some years owing to the expense and inconvenience of carrying on works 40 miles from the lake in a mountainous region with a poor road, badly located. This ore is found in Labradorite and differs entirely in its qualities from the ores of Clinton. The iron is very hard and tough and, like Swedish, has a remarkable affinity to steel, of which an instance has been given in the last number of this Journal. It will answer well for chain cables for which the Au Sable iron has been found to be too soft. One of the specimens tried by Professor W. R. Johnson of Philadelphia, was torn asunder by a weight of 67,000lb. pr. sq. inch, the average strength of 19 trials with 4 bars being 58,912lbs., that of, English cable bolt (E. V.) 59,105lbs.—Russia 76,069lbs. It is proper to observe that the iron of Essex county, was made in the rudest way under every disadvantage; had it been as skillfully manufactured as the English cable bolt, it would probably have fallen little short of the Russia iron.

With the common forge this mine could be of little value for many years, but if Mr. Clay's process succeed on a large scale, it must soon be worked, as the superior quality of the iron will justify the additional cost of transportation to the lake. Viewed in connection with this single deposite of ore, the new process must be considered not only important to the State but to the Union.* The enormous size of the veins has led Professor Emmons to suggest that the magnetic oxide may be "one of the constituent rocks of the globe, and ought to be described as such, and as it appears beneath the hyperthene rock, which is a variety of granite, it ranks lower in the series than the latter." Lastly, the allusion to this as the "great caldron" is well borne out. For the magnetic oxide is found only in the adjacent parts of the neighboring counties, as in the south-eastern part of St. Lawrence, in the southern half of Franklin, in southern Clinton, in eastern Essex and several localities between Adirondack and the Erie canal, but not in the neighborhood of Ontario or the St. Lawrence. These veins may be said to radiate from Adirondack as the grand centre of the upheaval of the Labradorite and the magnetic oxide of iron; the latter appearing near the base of the highest mountains in the State, composed principally of the former, and not again showing itself till we reach the coast whence it derives its name; which, proverbially inhospitable as it is, can scarcely exceed in wildness and savage grandeur the mountains and precipices of Adirondack.†

New York, *May*, 1842.

[From the New York Tribune.]

MR. LYELL'S FIFTH LECTURE ON GEOLOGY.—ORIGIN OF COAL.

[Continued from page 288.]

For even in the tropical zones, where we meet with large developements of the *caulopteries*, their general growth is much smaller than these fossil remains. So is it with all the plants of the fir tribe; many of them of which we find fossil remains in the coal now exist only in the southern latitudes, where no coal is found. The *araucarie* we now find in Chili, and other warm parts of the

* It is possible that the innumerable beds of peat found in northern New York, may some day be used in the manufacture of iron, and serve, to some extent, as a substitute for mineral coal.

† Three or four miles north of the works is the "Indian pass" through the mountains, the western side of which is a vertical wall of rock 1200 feet high. A few miles to the north east stands Mount Marcy, more than a mile high, with numerous other mountains, but little inferior in altitude.

globe, but never at the north, where its fossils abound in coal. The gigantic plants of the *equicetaceous* tribe are also found to be much smaller now in hot latitudes than are their fossil remains. This would lead to the inference that the climate in northern latitudes was then much warmer and more moist than it is now in any part of the globe. The same thing is made evident by a comparison of these fossils *sagillaria* with those which now attain their greatest size in the islands of the Pacific. I have also found several plants, as the *asterophyllites* in the Apalachian chain, this year, which I have also from Nova Scotia and Europe, and which cannot certainly be referred to any living families. These all, however, bespeak a terrestial vegetation, though occasionally found mixed with marine shells and corals.

Another class of fossils common in coal shales is the *lepidodendra* —somewhat allied in form to the modern *lycopodiums*, or white mosses. Though the mosses of the present day are never more than mere shrubs even in the warmest regions, yet at the carboniferous period they attained an enormous developemnt, being 40, 60 or even 70 feet high.

There have been two theories to explain how these plants could have been carried into the sea, estuaries or lakes, and drawn beneath the water and accumulated in the strata so as to form coal. One of them asserts that the plants must have been drifted and buried in the water, since we find them intercollated between different slates or shales; just as plants lie between the leaves of a botanist's *herburium* and are pressed together, so have these ferns been found flattened between the seams of shale. They have been carried from the place where they grew, drifted out to a certain distance; water logged and sunk in the mud and other strata deposited above them, so as to form this intercollation between the different leaves of clay.

But many believed, from seeing the roots, that the plants grew on the spot where we now find them. But when we come to observe that these roots terminate in different strata, it will seem evident that they were carried down, sunk and struck in the mud as snags are now in the Mississippi. In the quartrose sandstone at St. Etienne, near Lyons, are found a vast number of those *lepidodendra* and *sagillaria*. No one apparently can doubt that these drifted to their present position, and that they were afterwards covered with sand brought down by rivers. Many appearances favor this hypothesis. Sometimes we find beds of marine shells, then vegetabe matter and then a mixture of fresh water and marine shells.

But though these facts may be thus explained the discoveries that are being made lead geologists to come round more and more to the opposite view of the case—to the hypothesis which refers the growth of large beds of coal to the increase on the spot—after the manner of peat, as it is seen in cold and dark climates. This may appear contradictory to what I said with regard to a change of climate since the carboniferous era; but it is not necessarily so.

The opinion of Werner, confirmed by the speculations of Brongniart, led me to believe contrary to my early impressions, that by far the greater part of the coal had grown in the spot where it is found. Accumulating like peat on the land, the land must have been submerged again and again to allow the strata of sand and mud to be superimposed as we now find them.

In excavating for coal at Belgray, near Glasgow, in 1835, many upright trees were found with their roots terminating in a bed of coal; and only three years ago, in cutting a section of the Bolton railroad in Lancashire, eight or ten trees were found in a vertical position; they were referable to the *lepidodendria* species and allied to the *lycopodiums*, or club mosses. All were within 40 or 50 feet of each other, and some of them were 15 feet in circumference at the bottom. The roots spread in all directions and reached beds of clay, and also spread out into the seams of coal. There is no doubt that these trees grew where they are found, and that the roots are in their original position. The seam of coal has possibly been formed of the leaves which fell from the trees. This is a singular fact; that just below the coal seam and above the covering of the roots was found more than a bushel of the *lepidostrobus*—a fruit not unlike the elongated cone of the fir tree. It has always been imagined that the *lepidostrobus* was the fruit of the *lepidodendra;* but here they are found beneath other trees.

Under every seam coal in Wales is found the fire clay—a sandy, blue mud, abounding in the plants called *stigmaria.* First is the seam of coal, then the fire clay, then another seam of coal and then the sandstone. In one open part of the Newcastle coal field about 30 species of *sigillaria* were discovered: the trunks were two or three feet in diameter. They pierce through the sand in a vertical direction, and after going for some 11 feet perpendicularly, the upper part bends round horizontally, and extends latterally into the sand —and then they are so flattened by the supercincumbent strata, that the oposite barks are forced within half an inch of each other. The flutings are beautifully preserved in the flattened horizontal stems. Here we had an ancient forest growing in a bed of clay—buried in some way with sand to a certain depth, and then the upper part was bent and broken off by the water current, and buried in layers of shale and sand. There are many cases of this kind in Wales, where the roots of the trees evidently preserve their original position. Mr. Logan, an excellent geologist, has examined no less than 90 of these seams of coal in Wales. They are so exceedingly thin that they are of but little value in an economical light—yet they are just as important for geological purposes, as if they were thick strata. Under every one of the 90 he has found the fire clay, a sandy mud containing the plants called *stigmaria.* It was discovered years ago that this fire clay existed with the coal mine; but it was not known that it was the floor of every coal seam, and not the roof, which contained this plant in a perfect state. The *stigmaria* appears in the under clay (to use the term employed by miners,) a cylindrical stem, from every side of which extend leaves

—not only from the opposite sides, but from every side; they appear like tubercles, fitting on as by a joint. They radiate in all directions in the mud, where they are not flattened like the ferns. Had they been we might have had leaves in two directions, but not on every side. These plants resemble the *euphorbiaceæ* in their structure, and in some respects are analogous to the coniferous or fir tribes. In their whole structure they are distinct from all living genera or families of plants. In one instance a dome-shaped mass was found with stems and leaves —some of the branches being 20 or 30 feet in length and sometimes longer. It has been thought by Dr. Buckland and other geologists, that these plants either trailed along in the mud at the bottom of swamps, or to have floated in lakes like the modern *stratiotes.*

After Mr. Logan had arrived at this remarkable fact, we became particularly desirous to know if the same fact was true in the United States. When I arrived here in August, I had no idea how far it was true, yet it was known the *stigmaria* did occur; and my first oppertunity to enquire into the fact was at Blossburgh, in the bituminous field in the northern part of Pennsylvania. My first inquiry of the geologist was whether he found stigmaria there. I was answered in the affirmative; and on asking if the plant occured in the *under clay,* he said we could soon settle the point. He had one of the mines lighted up, and the *only plant we could find in the under clay was this Stigmaria:* it existed in abundance—its leaves radiating in all directions, just as in Wales, more than 4000 miles distant. The same crutal appearance was preserved. In the roof of the coal seam were seen different species of ferns,—*sigillari* and *calamites,* just as in North Carolina and in Wales. Afterwards another opportunity occured in the Pottsville region of anthracite coal. Professor Rodgers, the State Geologist, who, though well acquainted with the strata of the district, was as anxious as I was to know if the rule would hold good, examined first at Pottsville and at Maunch Chunk, when the same phenomena was observed. In the first coal mine we come to, the coal had all been quarried away (for the work was carried on in open day) and nothing but the cheeks of the mine remained. The beds, as they have been horizontal, are now not vertical, but have gone through an angle of little more than 90°, and turned a little over; so that what is now the under side was originally the upper; therefore the cheek on the left side was originally the floor of the mine. We now looked at the lower cheek; and the first thing we saw was the stigmaria very distinct; on the other side, but a little way off, were ferns, sigillarieæ, calamites, asterophyllites, *but no stigmaria.* So it was at Maunch Chunk, where we found one 30 feet long with leaves radiating in all directions. At this place there is a bed of anthracite nearly 60 feet thick—a magnificent accumulation of vegetable matter, to which there is nothing comparable in Europe. Except in one place it is perfectly pure.

It has now been ascertained for many years that Professor Eaton was quite correct in affirming the anthracite and bituminous coals to be of the same age. This is shown not only by their relative position with regard to the red sand-stone, but from the plants found in both being identical.

All the coal fields, therefore, may be regarded as one whole, and the question will occur, how did it happen that the great floor was let down so as to prevent the accumulation of coal and yet plants of so different textures should be found in it? It has been suggested that these plants grewin the swamps; and it is possible to imagine that there may have been morasses fitted only for the growth of the species of plants called *stigmaria;* and that this marsh filled up, this and the other plants became dry, and the leaves accumulated one layer above another, so as to form beds of coal of a different nature from those that preceded. You know it is a common thing for shallow ponds to fill up gradually with mud and aquatic plants and at last peat and trees are formed upon them. A corresponding change is constantly going on in different parts of Europe—the same transition from bogs and marshes to a soil capable of supporting various great trees is taking place, and then the ground is submerged; for always, again and again, we must refer to this subsidence of the soil.

Many of you, I suppose, have seen the morass called the great Dismal in North Carolina and Virginia; and you have probably had an opportunity, as I have, of crossing the northern extremity of it on a railway supported by piles, from Norfolk to Weldon. This is no less than forty miles from north to south, and twenty from east to west, covered entirely with various forrest trees, under which is a great quantity of moss; the vegetation is of every variety of size from common creeping moss to tall cypresses 130 feet high. The water surrounds the roots of these trees for many months in the year. And this is a most singular fact to one who has travelled only in Europe, that, as is the case in the United States, trees should grow in the water, and yet not be killed. This Great Dismal was explored some years since by Mr. Edmund Ruffin, author of the valuable Agricultural Journal. He first calls attention to the fact that a great portion of the vast morass stands higher than the ground that surrounds it; it is a great spongy mass of peat, standing some seven or eight feet higher than its banks, as was ascertained by careful measurements when the railroad was cut through. It consists of vegetable matter with a slight admixture of earthly substance, as in coal. The source of peat in Scotland is that one layer of vegetation is not decomposed before another forms. So is it in Chili, Patagonia and Terra del Fuego. Thus also is it in different parts of Europe, in the Falkland-Islands, as Darwin has shown. Thus too, is it in the Great Dismal, where the plants and trees are different from those of the peat in New York. It is found on cutting down the trees and draining the swamp and letting in the sun, that the vegetation will not be supported as it was before beneath the dark shade of the trees. In the middle is a fine lake, and the whole is inhabited by wild animals, and it is somewhat dangerous to dwell near it by reason of the bad atmosphere it creates. It is covered by most luxuriant vegetation. We find in some places in England that there is a species of walking mosses, which are sometimes siezed with a fancy to walk from their places: the moss swells up, bursts and rolls off, sometimes burying cottages in its path. In some places this peat has been dug into and houses have been found several feet below the surface—curious antiquarian remains. In the same manner the Great Dismal may spread itself over the surrounding country.

In speculating upon the probable climate of the carboniferous period, it is believed that we have only to imagine a different distribution of the land over the surface of the planet than that which now prevails, to produce such a warm and humid climate as must have prevailed when these plants flourished which form coal. It is the existence of high lands near the pole which produces such great cold. If these mountains were to be transferred to the tropical regions, it would immediately lower the temperature of all climates of the earth. Now every one who has attended to the study of rocks and fossils sees at once that the present physical geography of the globe has no reference to its ancient condition. Seas once occupied a large portion of what are now continents, and we also find evidences of marked change in the carboniferous and other strata. In the limestone accompaning the coal we find corals and shells, strongly indicating a higher temperature of the sea, as the plants shadow forth a higher temperature in the atmosphere.

I have been favored with a map illustrating these points by Professor Hall, one of the State Geologists engaged in surveying this State, whose labors will soon be made public. And here I cannot avoid saying that I have been over much of the ground which they have surveyed, and it gives me great pleasure to bear testimony to the accuracy of their labors, to the great pains they have taken, and the science with which they have conducted the survey. I look forward to the appearance of their work, embracing the results of their labors, as *an era in the advancement of science*; and the patronage which has been afforded by the different States of the Union to these surveys is much greater, in proportion to the population, than any European power has ever extended to the advancement of geological science. When we remember, too, the complaints that may be heard in different parts of the State that the geologists have failed to discover any mineral wealth, even in an economical point of view, these scientific researches are of high value, through their greatest interest arises from the promotion of the knowledge of the structure of the globe.

But merely in estimating the mischief they have prevented, we shall see an ample remuneration for all the expenses attending the survey. I have been told that in this State alone more than a million of dollars have been expended since the revolutionary war in boring for coal in formations where *it is impossible to find any*—below the carboniferous strata. I should not, to be sure, have ventured to generalize from Europe as a type and say that the rocks in the crust of the earth occupy the same relative position here, and the coal would be found always in this country under the same conditions as in Europe. But when for twenty years or more we find coal accompanied by the same plants, and that no valuable fuel has ever been found under any other circumstances we should be safe in saying that none could be found in the older strata. If we begin in the newer beds we may come down to the coal, and find enough coal to pay the expenses of boring for it. But if we begin in the strata beneath the carboniferous we should certainly never reach the coal until we had bored through the whole earth: we might find it at the antipodes but not before.

Thus complaints are made against these geologists not only that they have found no coal, but that they have passed sentence of sterility upon the State, for they say that through all time no coal shall be found within its borders. And when we reflect on the enormous sums that have been wasted upon strata more ancient than the coal, in searching for coal, we shall see the great saving made in consequence of this survey; for when all its maps and sections are published it will be seen how impossible it is to find coal in these mere ancient beds. This is a kind of advantage which is never easily appreciated: because, to prevent mischief is never so clear and palpable a benefit to the multitude as mineral wealth. But one of the greatest advantages which have resulted from these surveys in England, and it will be among the greatest here, is the prevention of this rash and absurd speculation to find coal in strata below that in which those plants known to be essential to the formation of coal are found to exist: and after examining the whole ancient strata, both in the United States and in Europe, there has never been found a single bed of coal where these plants do not exist.

REPORT FROM THE COMMISSIONER OF PATENTS, SHOWING THE OPERATIONS OF THE PATENT OFFICE DURING THE YEAR 1841.

PATENT OFFICE, *January*, 1842.

SIR: In compliance with the law, the Commissioner of Patents has the honor to submit his annual report.

Four hundred and ninety-five patents have been issued during the year 1841, including *fifteen* additional improvements to former patents; of which classified and alphabetical lists are annexed, marked A and B.

During the same period, *three hundred and twenty-seven* patents have expired, as per list marked C.

The applications for patents, during the year past, amount to *eight hundred and forty seven;* and the number of caveats filed was *three hundred and twelve.*

The receipts of the office for 1841 amount to $40,413 01; from which may be deducted $9,093 30, repaid on applications withdrawn.

The ordinary expenses of the Patent Office for the past year, including payments for the library and for agricultural statistics, have been $23,065 87; leaving a surplus of $8,253 84 to be credited to the patent fund, as per statement marked E.

For the restoration of models, records, and drawings, under the act of March 3, 1837, $20,507 70 have been expended, as per statement marked F.

The whole number of patents issued by the United States, previous to Janurry 1842, is *twelve thousand four hundred and seventy-seven.*

The extreme pressure in the money market, and the great difficulty in remittance, have, it is believed, materially lessened the number of applications for patents. These have, however, exceeded those of the last year by *eighty-two.*

The resolution of the last Congress, directing the Commissioner to distribute seven hundred copies of the Digest of Patents among the respective states, has been carried into effect, as ordered.

Experience, under the new law reorganizing the Patent Office, shows the importance of some alterations in the present law. One difficulty has been hitherto suggested, viz: the want of authority to refund money that has been paid into the Treasury for the Patent Office, by mistake. Such repayment cannot now be made without application to Congress. The sums, usually, are quite small, not exceeding $30. A bill has been heretofore presented, embracing these cases, and passed one House of the National Legislature; but a general law would save much legislation, and be attended with no more danger than now attends the repayment of money, on withdrawing applications for patents. Indeed, several private petitions are now pending before Congress, and are postponed, to to wait final action on the bill which has been so long delayed.

Frauds are practised on the community by articles stamped "pattent," when no patent has been obtained; and many inventors continue to sell, under sanction of the patent law, after their patents have expired. To remedy these evils, the expediency of requiring all patentees to stamp the articles vended with the date of the patent, and punishing by a sufficient penalty the stamping of unpatented articles as patented, or vending them as such, either before a patent has been obtained or after the expiration of the same, is respectfully suggested. Almost daily inquiries at the Patent Office exhibit the magnitude of such frauds, and the necessity of guarding effectually against them.

The justice and expediency of securing the exclusive benefit of new and original designs for articles of manufacture, both in the fine and useful arts, to the authors and proprietors thereof, for a limited time, are also respectfully presented for consideration.

Other nations have granted this privilege, and it has afforded mutual satisfaction alike to the public and to individual applicants. Many who visit the Patent Office learn with astonishment that no protection is given in this country to this class of persons. Competition among manufacturers for the latest patterns prompts to the highest effort to secure improvements, and calls out the inventive genius of our citizens. Such patterns are immediately pirated, at home and abroad. A pattern introduced at Lowell, for instance, with however great labor or cost, may be taken to England in twelve or fourteen days, and copied and returned in twenty days more. If protection is given to designers, better patterns will, it is believed, be obtained, since the impossibility of concealment at present forbids all expense that can be avoided. It may well be asked, if authors can so readily find protection in their labors, and inventors of the mechanical arts so easily secure a patent to reward their efforts, why should not discoverers of designs, the labor and expenditure of which may be far greater, have equal privileges afforded them?

The law, if extended, should embrace alike the protection of new and original designs for the manufacture of metal, or other material, or any new and useful design for the printing of woolen, silk, cotton, or other fabric, or for a bust, statute, or bas-relief, or composition in alto or basso-relievo. All this could be effected by simply authorizing the Commissioner to issue patents for these objects, under the same limitations and on the same conditions as govern present action in other cases. The duration of the patent might be *seven* years, and the fee might be *one-half* of the present fee charged to citizens and foreigners, respectively.

On the first alteration of the patent law, I would further respectfully recommend, that authority be given to consuls to administer the oath for applicants for patents. Inventors in foreign countries usually apply to the diplomatic corps, who are willing to aid any, and have uniformly administered the usual oath prescribed by the Commissioner of Patents; but as the Attorney General has decided, that consuls cannot, within the meaning of the patent law, administer oaths to inventors, a great convenience would attend an alteration of the law in this respect.

It is due to the clerical force of the office to say, that their labors are arduous and responsible—more so than in many bureaux—while the compensation for similar services in other bureaux is considerably higher. A comparison will at once show a claim for increased compensation, if uniformity is regarded. The chief and sole copyist of the correspondence of this office receives only eight hundred dollars per annum.

The Commissioner of Patents also begs leave to suggest the expediency of including the annual appropriations for the Patent Office in the general bill which provides for other bureaux. Objections hitherto urged against this course, inasmuch as the Patent Office is embraced by a special fund, have induced the committee to report a special bill, which, though reported without objection, has failed for two sessions, because the bill could not be reached, it having been classed with other contemplated acts on the calendar, instead of receiving a preference with other annual appropriations so necessary for current expenses. Were the appropriation for the Patent Office included in a general bill, also designating the fund from which it was to be paid, all objection, it is believed, might be obviated.

During the past year a part of the building erected for the Patent Office has, with the approbation of the Secretary of State, been appropriated to the use of the National Institute, an association which has in charge the personal effects of the late Mr. Smithson, collections made by the exploring expedition, together with many valuable donations from societies and individuals. While it affords pleasure to promote the welfare of that institution by furnishing room for the protection and exhibition of the articles it has in charge, I feel compelled to say that the accommodation now enjoyed can be only temporary. The large hall appropriated by law for special purposes will soon be needed for the models of patented articles, which are fast increasing in number by restoration and new applications, and also for specimens of manufacture and unpatented models. An inspection of the rooms occupied by the present arrangement will show the necessity of some further provision for the National Institute.

The Patent Office building is sufficient for the wants of the Patent Office for many years, but will not allow accommodation for other objects than those contemplated in its erection. The design of the present edifice, however, admits of such an enlargement as may contribute to its ornament, and furnish all necessary accommodation for the National Institute; and also convenient halls for lectures, should they be needed in the future disposition of the Smithsonian legacy. Whatever may be done as regards the extension of the present edifice, it is important to erect suitable outbuildings, and to enclose the public square on which the Patent Office is located.

Some appropriation, too, will be needed for a watch. So great is the value of the property within the building, that a night and day watch is indispensable. The costly articles formerly kept in the State Department for exhibition are now transferred to the National Gallery, where their protection will be less expensive than it was at the State Department, since these articles are guarded in common with others. The late robbery of the jewels, so termed, shows the impropriety of depending upon bolts and bars, as ingenuity and depravity seem to defy the strength of metals. A careful supervision at all times, added to the other safeguards, is imperiously demanded. I am happy to say that no injury or loss will be sustained from the robbery just alluded to, with the exception of the reward so successfully offered for the recovery of the articles.

By law, the Commissioner is also bound to report such agricultural statistics as he may collect. A statement annexed (marked G) will show the amount of wheat, barley, oats, rye, buckwheat, Indian corn, potatoes, cotton, tobacco, sugar, rice, etc., raised in the United States in the year 1841. The amount is given for each State, together with the aggregate. In some States the crop has been large, in others there has been a partial failure. Upon the whole, the year has been favorable, affording abundance for home supply, with a surplus for foreign markets, should inducements justify exportation.

These annual statistics will, it is hoped, guard against monopoly or an exhorbitant price. Facilities of transportation are multiplying daily; and the fertility and diversity of the soil ensure abundance, extraordinaries excepted. Improvements of only ten per cent. on the seeds planted will add annually from fifteen to twenty millions of dollars in value. The plan of making a complete collection of agricultural implements used, both in this and foreign countries, and the introduction of foreign seeds, are steadily pursued. It will also be the object of the Commissioner to collect, as opportunity offers, the minerals of this country which are applied to the manufactures and arts. Many of the best materials of this description now imported have been discovered in this country; and their use is only neglected from ignorance of their existence among us. The development of mind and matter only leads to true independence. By knowing our resources, we shall learn to trust them.

The value of the agricultural products almost exceeds belief. If the application of the sciences be yet further made to husbandry, what vast improvements may be anticipated! To allude to but a single branch of this subject. Agricultural chemistry is at length a popular and useful study. Instead of groping along with experiments, to prove what crops lands will bear to the best advantage, an immediate and direct analysis of the soil shows at once its adaptation for a particular manure or crop. Some late attempts to improve soils have entirely failed, because the very article, transported at considerable expense to enrich them, was already there in too great abundance. By the aid of chemistry, the west will soon find one of their greatest articles of export to be oil, both for burning and for the manufactures. So successful have been late experiments, that pork (if the lean part is excepted) is converted into stearine for candles, a substitute for spermaceti, as well as into the oil before mentioned. The process is simple and cheap, and the oil is equal to any in use.

Late improvements, also have enabled experimenters to obtain sufficient oil from corn meal to make this profitable, especially when the residuum is distilled, or, what is far more desirable, fed out to stock. The mode is by fermentation, and the oil which rises to the top is skimmed off, and ready for burning without further process of manufacture. The quantity obtained is ten gallons in 100 bushels of meal. Corn may be estimated as worth fifteen cents per bushel for the oil alone, where oil is worth $1 50 per gallon. The extent of the present manufacture of this corn oil may be conjectured from the desire of a single company to obtained the privilege of supplying the light-houses on the upper lakes with this article. If from meal and pork the country can thus be supplied with oil for burning and for machinery and manufactures, chemistry is indeed already applied most beneficially to aid husbandry.

A new mode of raising corn trebles the saccharine quality of the stalk, and, with attention, it is confidently expected that 1,000 pounds of sugar per acre may be obtained. Complete success has attended the experiments on this subject in Delaware, and leave no room to doubt the fact that, if the stalk is permitted to mature, without suffering the ear to form, the saccharine matter (three times as great as in beets, and equal to cane) will amply repay the cost of manufacture into sugar. This plan has heretofore been suggested by German chemists, but the process had not been successfully introduced into the United States, until Mr. Webb's experiments at Wilmington, the last season. With him the whole was doubtless original, and certainly highly meritorious; and, though he may not be able to obtain a patent, as the first original inventor, it is hoped his services may be secured to perfect his discoveries. It may be foreign to descend to further particulars in an annual report. A minute account of these experiments can be furnished, if desired. Specimens of the oil, candles and sugar, are deposited in the National Gallery.

May I be permitted to remark that the formation of a National Agricultural Society enkindled bright anticipations of improvement. The propitious time seems to have come for agriculture, that long neglected branch of industry, to present her claims. A munificent bequest is placed at the disposal of Congress, and a share of this, with private patronage, would enable this association to undertake, and, it is confidently believed, accomplish much good.

A recurrence to past events will show the great importance of having annually published the amount of agricultural products, and the places where either a surplus or a difficiency exists. While Indian corn, for instance, can be purchased on the western waters for one dollar (now much less) per barrel of 196 pounds, and the transportation, via New Orleans, to New York, does not exceed $1 50 more, the price of meal need never exceed from eighty cents to $1 per bushel in the Atlantic cities. The aid of the National Agricultural Society, in obtaining and diffusing such information, will very essentially increase the utility of the plan before referred to, of acquiring the agricultural statistics of the country, as well as other subsidiary means for the improvement of national industry.

I will only add that, if the statistics now given are deemed important, as they doubtless may prove, to aid the Government in making their contracts for supplies, in estimating the state of the domestic exchanges, which depend so essentially on local crops, and in guarding the public generally against the grasping power of speculation and monopoly, a single clerk, whose services might be remunerated from the patent fund, to which it will be recollected more than $8,000 has been added by the receipts of the past year, would accomplish this desirable object. The census of population and statistics, now taken once in ten years, might, in the interval, thus be annually obtained sufficiently accurate for practical purposes.

All which is respectfully submitted.

HENRY L. ELLSWORTH.

Hon. JOHN WHITE,
Speaker of the House of Representatives.

COAL FOR STEAMERS IN THE NAVY—STEAM BATTERIES.

It will be seen by an advertisement of the Navy Commissioners in another column, that the proprietors of coal mines are requested to furnish samples of their coal at the Navy Yard in Washington, for the purpose of having experiments made to test the qualities of the different specimens, with the view of ascertaining the kinds best adapted to the purposes of steam navigation in the navy.

The opportunity thus afforded will be a favorable one for proving the excellent qualities of the Alleghany coal in this State, which has been generally considered as possessing highly valuable properties for most of the use to which coal is applied as fuel. The bituminous coal of the Susquehanna valley, large quantities of which may be expected in this market, is also believed to be admirably suited to the purposes of steam navigation.

While we are upon this subject we may take occasion to repeat the expression of our earnest wishes, in which this community, we are sure, heartily join, that practical measures may be speedily taken for establishing some system of steam defences for the Chesapeake bay. The efficiency of steam batteries has not, that we know of, been fully tested; but is it not worth while to make some experiments to ascertain that point? The city of Baltimore and the whole region of the upper Chesapeake are as unprotected now as they were in 1814. The approaches by water to the city of Washington are as unguarded as they were at that period.

In the event of a war it would be highly desirable to have in the waters of our bay, in connection with floating batteries, several strongly constructed steamers, carrying heavy guns, yet adapted for shoal water, so as to allow them to enter the Patapsco, the Patuxent, the Potomac, and other rivers, and to guard the entrances of those important streams. A series of experiments to ascertain the proper form, size and construction of such vessels, might be with propriety commenced immediately. Some time and perhaps several attempts would be requisite in order to attain the desired ends. But every experiment would teach something—and something which cannot be learned without experiments.

Another idea may be here suggested. We see how steadily and perseveringly the British government is going on in the work of strengthening her steam marine. If we should be compelled into a war with England and it would be chiefly a maritime war; and to such an issue Great Britain is probably looking. She has adopted a new policy for this purpose by adding to the number and efficiency of her war steamers—that is to say, she has united with companies of private individuals for building and keeping afloat extensive lines of powerful steam ships to be used in time of peace for purposes of trade, and for the conveyance of passengers and mails across the ocean, yet adapted in all respects for warlike uses whenever occasion shall arise for their employment in that way. Now, what should prevent the adoption of a similar policy by this government in respect to the coastwise communication between our chief cities on the Atlantic seaboard and the Gulf of Mexico? We could have mail steamers running regularly from Portland and touching at Boston, New York, Norfolk, Charleston, Savannah, Mobile and New Orleans, with others connecting therewith and communicating with Philadelphia and Baltimore—the points of connection being at the Delaware breakwater for the one city and Hampton Roads for the other. These steamers would constitute the best kind of *home squadron;* they would partially pay their own expenses, and thus be of little cost to the government beyond that of construction; and they might be made, like the British mail steamers, ready at any time to receive armaments on board and fitted forthwith for war. An excellent school would thus be provided for the instruction of our officers in the efficient management of steam vessels—a species of skill which is every day becoming of vast importance, and which cannot well be acquired without training.—*Baltimore American.*

SHELL FISH FOR THE LONDON MARKET.

Not long ago, after a boat voyage in the southwest, where well wooded banks dip their bows into a broad, brimful, winding river that opens out from point to point into the semblance of a chain of lakes as it approaches the sea, we landed at a village celebrated for its "crabs"—spacious perforated trunks in which crabs, lobsters and sea crawfish are kept alive for the market. A large smack was lying at this village; and as the tide receded, the men began to discharge her freight. We went on board the craft. Her hold was divided transversely; in one apartment were hundreds of lobsters and sea crawfish; and there were as many crabs next door. The tide had left the wretches heaped upon each other, and among them a scrabling was going on, literally for life. The view of the struggling mass was more than painful; the convulsive motion of the long antennæ of the sea crawfish as they bristled up among the crowd, and the jerkings of the lobster's tails in a vain endeavor to swim away from their misery without water. There was a basket with a whip on a boom, and into these crowded black holes descended booted fishermen. Presently one of those familiars sang out "dead crabs!"—and up came the basket. An experienced glance was thrown over it by some on deck, and the best were picked out and carried to the boiler—thence to be hawked about the country as fresh crabs; but numbers were thrown away as past all culinary help. After a while there was a cry from below of "live crabs!" (males,) and up came the basket with its living load, and down it was lowered over the side, reversed, and the contents pitched *en masse* into the carb. Here at first was more misery; but at last the wrestling animals became disentangled, and there was almost an air of composure about the stronger martyrs as they crawled off to a quiet nook, there to breathe freely after the torture. The females were treated in the same way.

The more mercurial lobsters occasionally rushed upon their fate; when a basket of them was hoisted up, a particularly vivacious one would every now and then spring out with a sort of demivolte, and, falling on the deck, split his cuirass just above the point where the heart is situated; no sooner was he down and lying all abroad, than off he was hurried to the pot. It was at first a puzzle to think how it happened that they had not torn each other to pieces in the melee; for they were neither pegged nor tied: it turned out that the leading muscles of their claws had been cut, "that they might not quarrel." As in every deep there is generally a lower still, upon the removal of the crustaceans there appeared a tessellated pavement of oysters, and we almost fancied that we could hear them sigh their thanksgiving when the mass that had trampled on them was removed. Not that an oyster is much an object of pity under such circumstances, for he can make himself tolerably comfortable in his closed shell, the suffering of the lobsters, and crawfish must have been terrible; for in them the nervous system is highly developed.

A very little care would have spared the greater part of this agony and saved a considerable part of the eargo. If the well of the vessel had been fitted with iron gratings made to ship and unship, tier above tier, and a proper number had been allotted to each shelf, the crabs and lobsters would have been comparatively at their ease, with enough of moisture about their bronchiœ to enable them to breathe comfortably when left by the tide till they were transferred to the carbs. It must have been asphyxia consequent on the huddling together of such a congeries that killed so many.—*Quarterly Review.*

Perilous Position of St. Petersburg.—It is melancholy to contemplate the constant danger in which this brilliant capital is placed. If Mr. Kohl's picture is not overcharged, the occurrence of a strong westerly wind and high water, just at the breaking up of the ice, would at any time suffice to occasion an inundation sufficient to drown the population, and to convert the entire city with all its sumptuous palaces into a chaotic mass of ruins. The Gulf of Finland runs to a point as it approaches the mouth of the Neva, where the most violent gales are always those from the west, so that the mass of water, on such occasions, is always forcibly impelled towards the city. The islands forming the delta of the Neva, on which St. Petersburg stands, are extremely low and flat; and the highest point in the city is probably not more than twelve or fourteen feet above the average level of the sea. A rise of fifteen feet is therefore, enough to place all St. Petersburg under water, and a rise of thirty feet is enough to drown almost every human being in the place. The poor inhabitants are, therefore, in constant danger of destruction, and can never be certain that the whole five hundred thousand of them may not, within the next twenty-four hours be washed out of their houses like so many drowned rats. To say the truth, the subject ought hardly to be spoken of with levity, for the danger is too imminent, and the reflection often makes many hearts quake in St. Petersburg. The only hope of this apparently doomed city, is, that the three circumstances may never occur simultaneously, viz., high water, the breaking up of the ice, and a gale of wind from the west. There are so many points of the compass for the wind to choose among, that it would seem perverse in the extreme to select the west at so critical a moment, nevertheless the wind does blow very often from the west during spring, and the ice floating in the Neva and the Gulf of Finland is of a bulk amply sufficient to oppose a formidable obstacle to the water in the upper part of the river. Had the ancient sages of Okhta kept meteorological records, one might perhaps be able to calculate how often in a thousand years, or in ten thousand years, such a flood as we are here supposing might be likely to occur. As it is, the world need not be at all surprised to read in the newspapers one of these days that St. Petersburg, after rising like a bright meteor from the swamps of Finland, has as suddenly been extinguished in them like a mere will-o-the-wisp. May Heaven protect the city!—*Foreign Quarterly Review.*

American Railroads.—It is not many years since the question was arrogantly asked in Europe, "Who reads an American work?" But since then, not only our books but our institutions are deemed worth studying, and even special agents have been occasionally appointed by European Governments or associations, to travel through our land and inspect the peculiarities of our organization. Thus, France sent a commission to study our prison discipline system, and now, the Emperor of Austria has despatched to this country M. Giho, chief engineer of the Emperor's railroad; and Baron de Lehr, chief architect of the Vienna and Rabb Line, for the purpose of examining our railroads and reporting on their merits. It is said that they will be accompanied by several pupils of the Imperial Polytechnic school.

We have more miles of railroad than any other nation; we have longer continuous routes than any other nation, but in elegance of structure, in durability, in judiciousness of arrangements, in safety of transportation, the English roads are decidedly superior to ours. Their's are built for permanence,—ours for profit. They have wisdom on their side, we have thrift on ours.—*Savannah Georgian.*

Joel G. Northrup, of Courtland village, New York has invented a new printing press which although not constructed on the plan of the power press, it is said gives an impression to both sides of the paper before it is withdrawn. Sixteen sheets (printed on both sides) per minute can be stricken off by this press, yet its cost will not exceed one of those in common use.

AMERICAN RAILROAD JOURNAL, AND MECHANICS' MAGAZINE.

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[For the American Railroad Journal and Mechanics' Magazine.]

DURATION OF RAILWAY BARS.

In the March number of the Journal of the Franklin Institute is a description by Mr. Latrobe, of the new track, 96 miles, between Harpers Ferry and Cumberland on the Baltimore and Ohio railroad, to which Mr. Ellwood Morris, has appended certain remarks, which it would seem were more intended to bring his favorite *cast iron bars* into favor, than to do justice to the more approved and tried qualities of the *rolled iron bar*.

The following extract is in the form of a note, and as it contains the pith of his remarks, is sufficient to enable us to show that he has been too hasty in making up his mind on this important subject.

"Time was, when Engineers generally, were under the impression that rolled iron edge rails of 50 pounds to the yard, would last from 40 to 60 years, but experience is fast dissipating all such ideas, by demonstrating that the duration of rails of malleable iron is not determined by mere superficial wear, but, *by the time which it requires for a given trade rolling upon them, to dis rupt the bars into their elementary laminæ;* and the present indications of experience are, that upon railways possessing an amount of trade, equal to that which annually traverses the railroad between Philadelphia and Columbia, rolled iron edge rails of the T and H forms and of ordinary dimensions, will not endure more than ten years.

"That the public authorities of our State are becoming aware of the probability of this, may be inferred from the following extract taken from the late report on the condition of the Columbia railroad, made to the canal commissioners of Pennsylvania, by W. B. Hufnagle, Esq., the Engineer in charge of that work during the past year.

"'One fact, (says Mr. Hufnagle) however, cannot be concealed, that the iron rail which forms the heaviest item in the construction of a railway, exhibits strong symptoms of coming destruction, and even now, a portion should be replaced with new iron of an improved pattern;—the laminæ of which it is composed appear to have become detached, and exfoliate under the pressure of the cars, thereby requiring the rail to be reversed, or rendered useless,—this reversion has so frequently taken place that prudence would dictate the importation of at least 50 tons to supply the defective parts.'

"Here is a striking verification of the prediction made many years ago concerning rails of malleable iron, by W. Chapman, of Newcastle, a distinguished English Engineer, (see Wood on railroads) whose opinions were then strenuously combated by other engineers, who must now, or soon, admit, that Mr. Chapman's anticipations *were truly prophetic.*"

It would seem unaccountable how any Engineer, fairly entitled to be so called, can refer to the experience and results on the Columbia road, when it is so generally allowed that in no one particular has that illfated road had any chance of vindicating the merits of this invaluable improvement.—It has been a real school of experience, but in having been able to do so much under its many disadvantages, tells favorably for the value of others which have profited by its lessons, and are operating under the absence of most or all of the causes which have made it a failure; yet how seldom is any distinction made.

Mr. Morris ought certainly to have asked himself in the first instance, what might have been the quality of this particular rail on the Columbia road, manufactured near the infancy of the art, before proceeding to make general conclusions from it, such as that the T or H form of rail would be destroyed in 10 years by the passage over it of 1,500,000 tons. The following remarks taken from an article in the December number of this Journal, on the "manufacture of iron for railways," in England, will show the importance there attached to this subject, and, although much has been done, there is yet room for further improvement.

"A considerable portion of the evil arises from the fact, that, with some very few exceptions, neither the directors nor the engineers of railways, are practically acquainted with the manufacture of iron, and are therefore not aware of the immense difference which exists in the quality.

"One great evil attendant on the employment of iron of inferior quality, arises from the circumstance, that iron exposed to great and sudden changes of temperature, and to a constant percussive action is liable to a *slow and gradual* change arising from a re-arrangement of the particles among each other.

"The two great distinguishing features of wrought iron are known by the names of *cold short-iron and red short-iron*, the former being the toughest when hot, and the latter when cold—the cause of this great difference is still involved in mystery. We may imagine, therefore, that if any similarity exists between the two cases, that in possessing a *tendency to the cold short quality* will, when subject to the constant state of vibration to which it is exposed on railways, more rapidly deteriorate than *red short iron*, and become more crystalline in its texture, and therefore possess less cohesive strength.

"But, whatever may be the tendency to deterioration, there is far too little attention paid to procuring, in the first instance, iron which has been manufactured by processes likely to secure an approved quality.

"Now, the result of all this is, that the finished rails, instead of being of a tough fibrous texture, are only one remove from cast-iron in quality. Thousands, nay tens of thousands of tons of rails have been made and are now making in this way, and the directors and engineers are alike ignorant both of the practice and of the very serious results, to which it may lead.

"There are, however, other causes which determine the quality of iron, not less than the different process of manufacture. The minerals of some districts are naturally so weak that no art or care in the manufacture can render the iron made from them sufficiently strong for any description of railway work. The very general introduction of the hot blast has tended much to deteriorate the strength of pig iron."

It is thus seen how much depends on the original quality of the bar—and that the slow and gradual deterioration (like the poison in tea) arising from the percussive action of the trade rolling over it, is only somewhat quickened by a tendency to the *cold short* quality;—at any rate, the progress to decay of the ordinary rolled bar, from this cause, is quite inconsiderable.

The real cause, however, of all the mischief is in the hammering effect of the locomotive, and the slipping of its drivers in certain states of the weather—and this will be in a *double compound* ratio over a neglected track, such as that of the Columbia road. But Mr. Morris does not distinguish between this destructive action and the comparatively harmless one of the mere rolling friction of the car—and we are sorry to find Mr. Hufnagle, the engineer of the Columbia road doing the same, as is seen in the above extract from his report, in which he attributes the exfoliation of the rail to the *pressure of the cars,*—when it is notorious to the merest tyro, that this is caused altogether in the first instance, by the locomotive, and mostly in the shorter curves. This evil is scarcely felt in England where they have few curves, or if any of immense radii.

It is very evident that Mr. Hufgnale in his said report, has given an undue importance to this matter of exfoliation by his expression, that "symptons of *coming* destruction" are seen in it, which has alarmed Mr. Morris for the whole track—who overlooks that Mr. Hufnagle himself in that very extract, had proved its insignificance by asking for only 50 tons to replace the destruction from this cause, after seven to eight years of *abuse* of the road—a demand equal to only 7 tons per ann., or $350: but allowing it to be 50 tons per ann. at $50 per ton, it is only $2,500, which on an average of only 100 miles of track, being mostly double, only requires at that rate of wear, the small item of $25 per mile per ann. to renew the whole of it, and which would be *nearly refunded by the sale of the old iron.* The really expensive item about a railway is therefore the labor of adjusting and levelling the track, amounting fully to the whole cost of the renewals, and the two together on a good road ought not to exceed 6 to $700 per mile per annum.

Mr. Morris estimates the amount of tonnage which has passed over the Columbia road in the last seven years at 1,300,000 tons in cars and locomotives, which, he says, has reduced the rails to their present *dilapidated condition;* and hence infers that two millions of tons would be sufficient to crush off the top tables of the rails and to render them entirely useless. He has, however, in allowing 3 tons to a car, only given the weight of the car—in which on an average there is a loading of 2½ tons—this added to his estimate will make up the tonnage to two millions as already passed over the road, and by which it should now be accordingly destroyed; but which Mr. Hufnagle disproves by asking for only 50 tons to replace the destruction in 6 to 7 years out of nearly 7,000 tons; so that neither Mr. W. Chapman of Newcastle, England, nor Mr. Ellwood Morris of Philadelphia are likely to be considered the prophets they would be, in this matter of the speedy destruction of the rolled malleable bars. We have another and competent witness to bring on the stand against the assertion of the present *dilapidated condition* of the rails on *even* the Columbia railroad.

Mr. Sano, for many years an engine-driver, afterwards for a long time foreman to Mr. Morris' locomotive manufactory, and lastly in charge of the repair-shop of this very Columbia railway for the past 14 months, thus conversant with the properties of iron, asserts that the rail is in the main as good now as the day it was laid down; and this he considers the more wonderful, as the iron was never of the best sort—the rail is of the inferior T form, feebly supported on slight cross ties with a chair at each, the whole forming a ricketty track—the weight of the rail also being inadequate to the various locomotives which have been run on it at times by the most unskilful and careless enginemen. Recently there have been laid 28 miles new track with a heavier rail of the H form; and the effect on passing to it with the locomotive from the old T track, he describes as similar to the passage of a common carriage from a stone pavement to a wooden one; and hence, may be inferred, the immense saving in both road and machinery, when the rail is firm and rigid, and the track in good adjustment. He has no faith in being able to use the *cast-iron bar* with locomotive power, owing to the difficulty of casting a bar of any length with a uniform temper—the effect of the locomotive, particularly when its drivers slip, being to tear and blister the surface very soon, making of it a succession of hills and dales. This action is seen on the cast-iron switches; and near the Columbia Bridge there are some cast-iron sidings affected in this way, the locomotive passing over them once only to ten times over the rolled iron bars alongside of them, which continue unharmed. With horse power the cast-iron bar will continue to be found serviceable for lateral roads.

Over the Mine Hill railroad with a rolled iron bar of 35 lbs. per yard using horse power, there have been passed about one million of tons of cars and coal, and this rail is as good as it ever was; but in anticipation of connecting with the main stem to Philadelphia, and using locomotives, it has been replaced by a heavier rail of 62 pounds per yard. By the report of the Camden and Amboy road; after 8 years at the points most used, the rail is declared to be perfectly sound; and the evidence is abundant enough both here and in England, that for an approved form of H rail,* thirty years of useful duration, is a fair term without limit of trade, during which period, a small allowance of $40 to $50 per mile per annum, at the present cost of iron, will pay for its gradual renewal, or rather for the difference between the old and new iron, including the expense of relaying.

It is not now of much consequence to know what it cost to lay a track at the prices of 1836 and 1837, a period of the highest inflation of the currency—it is at present on an everage 33 per cent. lower, and the new track superstructure of the Baltimore and Ohio road cannot cost over $8,000 per mile, in place of near $11,000 as made by Mr. Morris—the B ridge form of rail or U pattern, adopted for this road, is deemed preferable to the H form by many experienced judges, but as yet it has not been long enough in use to determine its superiority over the later forms of H rail. The price of railroad iron delivered in this *country is* now about $42 per ton.

A false dread of the early destruction of the rail, very soon after it gets into use is almost universal; nor is this surprising, when the many imperfections in the earlier structures are considered, but now that these have been mainly remedied of late, and further improvements are every day being made, all true friends of the cause should do their best to convince the public of this important fact. But all such efforts will be in vain, if the *idle hearsay*, from which the mass take their impressions, as interest dictates, is to receive *apparent* confirmation, because presented to them in works of authority, the contributors to which are supposed, as professors, to have investigated and to understand the subject on which they treat.

In conclusion it is not risking much to assert, before those who have studied this subject practically, that the improvement in quality and form of bar, in more firmness of track generally, a more equal destribution and greater effect of the weight or adhesion of the locomotive, stronger cars, and a more moderate speed for freight—these with more skilful management in minor details, all combine to produce for the future on the railway, the creation of only yesterday,

*There are now on the Philadelphia and Pottsville line of railway, three different formed sections of rail of the H pattern—one of 45, one of 52 and one of 62 pounds per yard, the latter on the mine hill branch. That of 52 pounds was intended as an improvement on the one of 45 pounds and was said in England to present the best possible distribution of its weight for strength, and we believe it would be considered quite as strong as that of the 62 pounds, on which the additional 10 pounds per yard appear wasted in an unnecessarily wide base.

far less wear and tear, and have reduced it down to a ratio on the receipts, which ensures a reasonable dividend on all such as connect desirable points. Wear and tear must always exist—it has been gradually and will be yet further reduced on the railway, but at even the present *average ratio* of 35 to 40 per cent. which allows for its *entire renewal*, the good derived from it relatively to that to be obtained from any other improvement, perhaps nominally less expensive, must hereafter secure it a preference of adoption in a large majority of cases.

The following article from the Chronicle and Sentinel of Augusta, has been examined and commented up by Mr. J. E. Bloomfield at our request. It will be perceived that the statistics of *four* out of the *seven* roads in the table have been copied exactly from our Journal without any notice of acknowledgement of the source whence they are drawn. We are most happy to acknowledge the labors of the gentleman who has prepared the table as far as the addition is concerned, and every such addition is a new element in our views of railway science. But it is no more than fair to acknowledge that the plan of table is that prepared for several years expresly for this Journal by our friend Mr. Joseph E. Bloomfield and recommended by him as a model for this purpose. We are glad to find new laborers in the cause, but must protest against making use of our labors, who as pioneers have borne the heat and burden of the day, while those who come in at the eleventh hour obtain the penny we cannot get.

We insert the table as we find it for the purpose of comparison, and hope that the hint may be improved upon, and finally, that all the railroads in the country may have their yearly statements tabulated in a similar manner, and with the improvements suggested.

“ RAILROADS.

“ We are indebted to a gentleman of this city, who takes a lively interest in whatever relates to railroads, for the following condensed tabular statement of the cost, receipts, expenses, nett profits, etc., of several roads, which enables the reader, at a glance, to compare the relative value and management of each. This exhibit is highly flattering to the Georgia railroad, but we are quite sure not more so than is due, for we are confident there is no road in the Union, in the building and management of which a more rigid economy has been practised.”

Comparative view of the cost, receipts, expenses, and nett profits, of the following railroad companies, for the year ending during the winter and spring of 1842, *as shown by their last report.*

Name of Road.	Length.	Expended in cost of road & machinery.	Cost of road per mile.	Repairs of engines and cars.	Repair of road.	Repairs of road per mile per year	Fuel, oil, salaries & incidental expenses.	Total expenses.	Total receipts.	Income from passengers.	Income from freight & mail.	Dividend per annum.	No. miles run by engin's during year.	Cost per mile run by engin's exclusive of interest on capital.	Total expense per mile of road per year.
Boston and Lowell.	25¾	1,834,193	71,290	22,644	33,193	1,200	63,631	119,469	267,541	145,953	121,588	8	125,300	81¼cts.	4,640
Boston and Providence.	41	1,782,000	43,460	12,722	24,474	597	84,857	122,057	230,821	152,015	78,806	7	107,638	93	2,977
Boston and Worcester.	44½	2,374,547	53,360	27,584	34,900	784	100,514	162,998	310,807	190,097	110,000	7	175,000	93	3,660
Eastern.	60	2,267,000	43,000	17,820	31,117	520	94,381	154,958	299,574	257,734	41,840	6	191,900	81	2,580
Petersburg and Roanoke,	60	826,000	13,766	16,513	36,534	609	43,351	96,398	174,184	43,976	130,208	7			1,606
Charleston and Hamburg,	136	2,400,000	17,647	67,986	74,456	547	101,987	244,429	322,740	136,937	185,803	3½	253,560	96½	1,720
Georgia Railroad,	147	2,350,000	16,000	15,724	38,692	264	36,784	91,200	224,255	71,460	152,795	6	152,520	60	620

[For the American Railroad Journal, and Mechanics' Magazine.]

I have examined, at your request the article made up for the Augusta Chronicle and Sentinel, of the 12th Inst., by a gentleman of that City, and am gratified to find that the tables prepared for your Journal for the last four years, from the Official Reports of Massachusetts, have been serviceable to the Railway cause, by a comparison of receipts, expenses, repairs, fuel, etc.

* The good management of the Georgia railroad is as creditable to its directors, as the ill success of the Charleston and Hamburg railroad shows some decided defects, if we compare the proportion of *Receipts*, with the *Expenses*. On the Georgia railroad, all the expenditures are $91,200, 41 per cent, to receive $224,255. On the Charleston and Hamburg railroad, the expenses are at the extravagant rate of $244,429, or 76 per cent, to receive $322,740. This requires explanation.

On the Petersburg and Roanoke railroads the Expenses, proportioned to the Receipts are about 55½ per cent., $96,398, to $174,184.

On the best conducted railroads in the state of New York, the ratio of expenses to receipts is about 33 per cent.

A principal item in the expenses of Southern and all roads, is certainly less than in the Northern railroads;—I allude to Fuel.—The comparison is very striking, as between the Boston and Worcester railroad 44¼ miles, and the Georgia of 147 miles, in the items under the heads of "fuel, oil, salaries and *incidental* expenses"—over the Boston and Worcester railroad 175,000 miles were run, for $162,998, or 93 cents a mile, exclusive of interest on the cost of the road.

Over the Georgia railroad, the distance run was 152,520 miles, for $91,200, or, at the exceedingly low rate of 60 cents per mile.

The saving appears to be in "*fuel*, oil, and incidental expenses."

On the Boston and Worcester railroad, these items are placed at $100,514; on the Georgia, at $36,784. This discrepancy is stated in remarks on the table alluded to [page 172, vol. 8, No. 6] of your Journal, to arise from the necessity the Boston and Worcester railroad was under to submit to "a change and improvement in the line of their road, and *Depots* to meet the heavy freighting business this railroad must be prepared for, since the completion of the Albany, West Stockbridge and Western railroad to the outlet of the Erie canal." The track has been doubled 20 miles. The principal freight depot covers an area of 56,000, feet. Items strikingly applicable to working the railroads ought only to be admitted.

Taxes, accidents, and new works should be separated, or, it is impossible to arrive at correct conclusions.

It should be further noted, that the Boston and Lowell railroad, with a heavy edge rail, has a double track. It is equal to 51 miles of the Georgia railroad, therefore, the total expenses per mile should be placed at $2,320 per mile instead of $4,640 per mile, by the author of the table. In making comparisons, a still further deduction in the road of $14,638, or above $600 per mile, should be made, for taking up 7 miles of the track laid with 36 lb. rail, and replacing it by rail of 56 lb. to the yard. This is noticed by the report, but not by the editor of the Georgia paper.

The Boston and Providence, and the Boston and Worcester railroad are partially double.

It would have added much to the value of the table if the weight of the iron per yard,—if flat, or, of the edge or T form had been given, and the expenses of working the road, kept separate from the repairs to engines and these again separate from the repairs to the cars. It would, perhaps have accounted for the great difference in the comparative expenses on the three southern railroads inserted in conformity to the plan prepared for your valuable Journal, from the very meagre reports, made to the Massachussetts Legislature.

The table may be much improved, and railroad Companies are invited to contribute to this useful class of information, for the benefit of stock holders.

J. E. B.

[For the American Railroad Journal and Mechanics' Magazine.]

The following Memorial from *the New-York and Erie Railroad Company,* to the legislature of the State of New-York of this year, it may be well to preserve for future reference, as the day may come when the state will be unwilling to own that it had once refused to continue its aid to this great and useful work. We trust sincerely it has only been made a temporary sacrifice to the malign influence of politics, aided by the jealousy of the canal interest, and more particularly that of the Delaware and Hudson Canal, which although joining in the cry against railways as suited to the carriage of heavy freight, were yet considerably alarmed lest this road be allowed to connect with the same coal region, which is now solely dependent on them for an outlet to market. This, coupled with the necessity for muzzling the railways along side of the Erie canal, should arouse the people of the State to deliver themselves from being thus canal-ridden, and imitating the other more enlightened portion of our own country, and the general practice at present in Europe, to turn their attention more to railways as the best suited to give the greatest elasticity to trade.

Russia is about undertaking a work of equal magnitude to the New-York and Erie railway—the project being to connect St. Petersbugh with Moscow, a distance of about 470 miles. She has sought among our engineers for a superintendent of this splendid enterprize, and her enlightened Emperor sees clearly enough that his empire now extended and weak, will be made, by a judicious management of this improvement, compact and strong. In short, as a matter of self-defence, the different states of Europe are now *fortifying* themselves with railways, which operate not by the destructive discharge of bullets, but by the beneficent spread of social feeling and of industrious habits.

"MEMORIAL IN FAVOR OF THE NEW YORK AND ERIE RAILROAD.

"We, the undersigned citizens, residing on and near the route of the New-York and Erie railroad, unite in this memorial without distinction of party: and after a full and deliberate reflection upon the present financial condition of the State, and of the public works unfinished and in progress.

"It is not our design to discuss, or avow an opinion upon the controverted question as to the ability of the state to make large appropriations for rapid progress in those works, or her policy touching that question. Our object is to declare, in plain and unequivocal terms, our opinion of the just rights and claims of the southern and southwestern counties, collectively—and as contrasted with other portions of the State—having particular reference to the Erie canal, and the New-York and Erie railroad.

"We have always doubted the policy of the Erie canal enlargement. We believe that if the original canal had been improved, by clearing its bed and doubling its locks, and the State had adopted and made the New-York and Erie railroad—we should have had every required facility to secure the trade of the west—while the convenience and prosperity of our citizens would have been more widely diffused and promoted. Different counsels have, however, prevailed. The state is already deeply committed in the enlargement; while the railroad is left mainly to the doubtful efforts and results of private enterprize. But the most mortifying and objectionable feature in this policy is yet to be stated. Vast sums of money, have been already expended on this enlargement, which has furnished the principal ground for alarm and proposed taxation.

"The millions already spent have been, and the millions yet to be required will, doubtless, be demanded and obtained as a matter of course, and almost without discussion, upon the plea, that the canal is a State work, and the State must provide for its own. While, on the other hand, our Legislature refuses to adopt the railroad—and then hesitates in extending aid because it belongs to a private company! Such an apology for exhausting all the resources of the State upon the line of the Erie canal, is regarded by us as neither satisfactory nor admissible. We can regard no legislation as either equal or just which does not respect alike all sections of the State. It is not our fault that the New York and Erie railroad has not been adopted by the State. And, in truth, we deem it of little moment, in reference to our own claims for State aid, who owns the road, provided the laws secure to us fair and equal privileges in its use and accommodations, We want the road not for its tolls and direct profits—but to settle our new lands—give a quickening impulse to every department of industry and enterprise among us—and to afford those aids and conveniences to our citizens at large, which they cannot otherwise enjoy.

"Again—it cannot be expected that the railroad in question can be completed by unaided private enterprize; and we consider that our citizens have full right to claim that if the unfinished works on the canal shall progress, provisions shall also be made for the continuation of the work on the railroad. If appropriations to the canal are urged on the grounds of preventing waste in unfinished constructions, or in materials already provided, with equal force may such a claim be made in behalf of the railroad. On its almost entire line are a half constructed railway, many unfinished bridges culverts, and a vast amount of timber exposed to deterioration or utter waste, half completed contracts, the suspension of which would, in numerous instances, ruin the contractors; and, in short, we allege that even a suspension on the work for a single season would produce, almost throughout the line, deep pecuniary embarrassment, and no little absolute distress. On every great work of this kind, whether controlled by the State or individuals, the interests of the whole community within its influence, become so involved and intertwined, as to render it mainly public in its character and results. And in respect to the railroad in question, it is in fact peculiarly public property by the liberal portions of stock which have been taken by citizens on its extended lines—not with a view to pecuniary profit, but to aid in its construction.

"The citizens of the southwestern counties are doubtless as truly patriotic, and as zealous for the general welfare as those of any portion of the State, and would as cheerfully submit to a sacrifice of local interest when the necessity of the State shall demand it. If the exigencies of the State demand an entire suspension of the works in progress—or, if appropriations must only be reduced—or, if active progress may be prudently made, when sustained by by reasonable taxation—we doubt not that our citizens would cheerfully yield to any required correspondent legislation. But we can never consent that the State shall refuse either to adopt or lend its needful aid to the completion of the New York and Erie railroad, while it lavishes all its disposable resources on other portions of the State, more powerful to enforce demands, or more favored in their importunities.

"In making these declarations, and avowing *our settled determination to maintain them in every constitutional way in our power*, we disclaim every intention to countenance or uphold any improvident appropriation or wasteful expenditure of public money, and we desire to see in every law making such appropriations, every precaution and safeguard against extravagance.

"In conclusion, we remark, that if it shall be deemed by a majority of your body, most for the interest of the State, to suspend for a season the usual annual appropriations of stocks for the prosecution of public improvements—we, nevertheless, believe that some legislative aid may be rendered to the New York and Erie railroad, which will neither increase State stocks, nor very materially enhance State liabilities. Such an object will, as we believe, be attained by passing the bill recently introduced by Mr. Faulkner, a Senator from the sixth district. And such being our belief, we unite in our request for the passage of that bill.

March, 1842.

"HOT AIR BLAST."—IMPORTANT TRIAL.

J. R. Neilson the well known inventor of the Hot air blast, has commenced suits against many of the iron companies using his Patent without permission. Some technicalities it seems prevented him from obtaining the benefit his invention entitles him to recieve.

At a recent trial however in Glasgow, a Jury found in his favor, and in such a manner as to leave no room for further difficulty. The damages were assessed at £3060 sterling, at the rate of 11*l.* 16*s.* per ton for all the iron smelted since the plan of Mr. Neilson has been adopted

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We take pleasure in making known the following Report of the Committee of the Franklin Institute on Messrs. Baldwin and Vail's new locomotive engine.

Some time since, our readers may recollect, we gave an account of this engine and its improved advantages.

BALDWIN AND VAIL'S LOCOMOTIVE ENGINE.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a six wheeled, geared, Locomotive Engine, intended for the transportation of heavy freight trains, manufactured by Messrs. Baldwin and Vail, of Philadelphia, Pennsylvania, Report:—

That the sub-committee appointed to examine the above mentioned engine, met upon the Columbia railroad on the 25th of January, 1842, and went with the engine out to the Schuylkill bridge, and returned with it to Broad street, drawing a train of burthen cars, the gross load being about 200 tons, which was much below the limit of the engine's power, but included all the cars that were then ready to be brought in.

The peculiarity of this engine consists in its obtaining the adhesion of the four wheels of the truck, in addition to that of the main driving wheels, without preventing the truck from vibrating so as to accommodate itself to the curves and undulations of the road. Experience upon the American roads, as far as known to this committee, proves that engines having six wheels and provided with leading trucks, move much more steadily than those with only four, and, as a partial loss of power and other injurious consequences result from the slipping of the driving wheels of locomotives, (which often occurs to a considerable extent, even when it does not prevent the engine from drawing its load, and is not noticed by the engine-man) it is very desirable to obtain the adhesion of all the wheels, without losing the advantages of a vibrating truck.

The difficulty in doing this arises from the fact, that when the engine stands on a curve, the axles of the truck wheels are not parallel to that of the main driving wheels. Messrs. Baldwin and Vail obviate the difficulty in the following manner. A pair of main driving wheels, forty-four inches in diameter, are placed behind the fire-box, as in their well-known form of engine, but the axle, instead of being cranked, is straight, and the connecting rods from the pistons of the cylinders have outside connections; and attached to the same wrists are other connecting rods, extending forward and giving motion to a shaft under the front part of the boiler and between the axles of the truck, which shaft is secured so as to maintain its parallelism with the axle of the main driving-wheels, at right angles to the axis of the boiler. On the middle of this shaft a cog wheel is fixed, having chilled cogs slightly rounded on the face, which, by means of two intervening wheels, give motion to others on the axles of the truck. The four truck-wheels are thirty-three inches in diameter, and the gearing is proportioned so as to make them travel at the rate of the larger wheels.

The steam cylinders are thirteen inches in diameter and sixteen inches stroke. The gross weight of the engine in running order is 29,980 pounds, which is apportioned so that 11,755 pounds, are on the two points of contact with the road behind the fire-box, and 18,225 pounds on the four points of contact under the truck. When tried upon the Columbia railroad in the presence of the committee, the engine drew its train readily around curves of 757 feet radius, the rounded surfaces of the chilled cog gearing allowing the axles of the truck to suit themselves to the curvature of the track. The engine passed with ease around a curve of ninety degrees, having a radius of 312 feet, the train being detached, and afterwards backed itself around a curve of seventy-five feet radius without difficulty.

The engine has since been in use upon the Reading railroad, and it appears from a certificate of Mr. Nicolls, the Superintendent, that on the 12th of February, it drew from Reading to the Columbia railroad, a distance of fifty-four miles, a train of 117 loaded freight-cars; the cars weighing 215, and the freight 375 tons, making a gross load of 590 tons. The speed when in motion being ten miles per hour.

In the opinion of the committee, this engine combines in a high degree the advantages of a vibrating truck with the use of the adhesion of all the wheels; they think it well worthy of the attention of railroad companies doing a freighting business, and believe that it will add to the deservedly high reputation of the builders.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

February 21st, 1842.

CORROSION OF IRON IN STEAM BOILERS AND STOVE PIPES.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the Corrosion of Iron in Steam Boilers and Stove Pipes, where Anthracite is employed as fuel, Report:—

That they have gathered such information as lay in their power from those who have witnessed the corrosive action, and combined it with their own observations.

It appears that stove-pipes are frequently corroded in the course of a year or two, where they are not taken down or cleansed subsequent to their employment through the winter season. An instance is known in which forty feet of pipe were corroded and rendered a perfect colander in the course of two years. Nor does it appear always as a necessary condition that the place should be damp, although this is the case in a majority of instances, for in the corrosion just noticed, the proprietor stated that the stove was very dry. The corrosion rarely happens in an upright pipe, but usually in one lying horizontally, for where such corrosion had already commenced it was said, in one instance, to have been obviated by giving the pipe a slight inclination. Where it takes place in an upright pipe, it may arise from the flowing down of corroding matter from a horizontal layer of the same.

The same kind of corrosion is observable in steam boilers in which anthracite is employed as fuel, and not in those in which bituminous coal is used. That it does not arise from the intensity of the heat is shown from the fact, that it is greatest in the boiler-flues which lie horizontally at a distance from the fire. A corrosion is sometimes observed near the top of the smoke pipe in steamboats, but this may be attributed to the alternate action of heat, cold, air, and moisture.

It would appear then, that the corrosion is caused either by the vapors arising from the combustion of anthracite, or from matter carried up mechanically by the draft; or from both combined. That it does not proceed from uncondensable gaseous matter is proved by the occurrence of corrosion only when a stove-pipe is no longer exposed to these vapors, during the summer season, or where a boiler is cooled from intermitted fires. It does not arise from matter carried up mechanically, for this could only be ashes, and we know that the ashes of anthracite is of a dry nature; and without moisture, chemical action, or the corrosion, could not occur. It must, therefore, be produced from condensable vapors.

On examining the interior of a stove pipe lying horizontally, whether corroded or not, we find a loose ashy deposite of a greyish brown color; and where corrosion has taken place, the greater part is condensed into a solid mass, showing that it had absorbed water. Upon fracturing the solid material, small white crystals appear under the microscope, which are generally too imperfect to admit of recognising their form. By subliming the mass, a little empyreumatic oil and water are formed, but the greater part sublimed is an ammoniacal salt. Upon testing a solution of the ashes, it shows a large content of muriate and sulphate of ammonia, the former evidently in much greater quantity than the sulphate. After complete sublimation at a red heat, the ashy matter remaining appears to be nearly pure charcoal or lamp black, with a mere trace of coal ashes. From the qualitative tests made, it would appear that the ammoniacal salts constitute at least three-fourths of the whole mass. A mere trace of iron was detected.

From this content of saline matter, as well as from its nature, we are at no loss to account for the corrosion of iron where the air and moisture add their conjoint action; but it may be doubted whether the ashy matter has the power of absorbing moisture from an atmosphere of ordinary dryness, for in dry situations it appears that there is usually no corrosion, and in the case noticed at the commencement of the report, it may be doubted whether the stove was dry.

How to obviate the corrosive action is a more difficult point to determine, unless the very simple process be resorted to of cleaning out stove-pipes every spring, and boiler-flues every few weeks.

If the stove pipes are required to remain standing with the sediment in them, then a previous internal coating of white lead, litharge, or red lead might probably answer the best purpose, since it would result in the production of chloride and sulphate of lead; while the ammonia would be driven off. The thin coating of these salts of lead might then prevent the contact and the further action of the ashy deposite. Experiments made in the U. S. Mint during the winter of 40—41, seem to show that a coating of lime on the interior of a pipe prevents corrosion, and it is said that a few stove manufacturers in this city are acquainted with the fact. The committee, however, in the face of these facts, are rather inclined to believe that the oxide of lead will prove more efficient, since the sulphate of lead is a wholly inert salt, and the chloride nearly insoluble, while sulphate of lime is somewhat soluble, and the chloride of calcium very soluble and therefore likely to produce corrosive action eventually. Still the operation of whitewashing is the simplest mode of obviating corrosion, and may be repeated at intervals.

The content of chlorine to such an extent as is developed by the above chemical examination, is interesting in a geological point of view, since it has not hitherto been found in chemical examinations of anthracite.

Prof. H. D. Rogers, in 1836, pointed out the fact, that where heaps of refuse matter were burned near the coal mines, ammoniacal salts, and among them muriate of ammonia are sublimed, and may be found among the ashes. Now we know that saline waters are obtained from the coal measures in the western district of Pennsylvania, and moreover, it is the prevailing opinion among Geologists that the coal series are marine deposites; we can therefore explain the origin of the muriate of ammonia in the ashy deposite arising from the combustion of anthracite, by attributing the chlorine to the presence of a trace of chloride of sodium. (common salt) in the coal or its accompanying slate, or possibly in both. It is unnecessary to allude to the formation of ammonia, since it is a universal product to a greater or less extent of the dry distillation or combustion of every kind of coal.

The ammoniacal deposite is interesting in an economical point of view, since it accumulates in considerable quantity in a single season, and may be collected with facility. In one instance at least, ten pounds were removed from about eight to ten feet of pipe, which was the produce of three or four years, and hence, we may estimate the large amount that might be obtained from many hundred pipes in Philadelphia every season. It may be employed either for the manufacture of salt ammoniac by a very simple process of sublimation with a small quantity of salt of lime, or it may be directly applied in powder or in solution to garden soils. The influence of ammoniacal salts in promoting luxuriant vegetation has been long known, but the admirable work of Professor Liebig on Agricultural Chemistry, has more completely developed their influence and importance. The material before us will unquestionably prove of great value to the gardener and florist, if properly applied to the soil; but it must not be forgotten that it is very rich in ammonia, and should therefore be employed sparingly.

By order of the Committee,

February 10*th*, 1842. WILLIAM HAMILTON, *Actuary*.

From the Civil Engineer and Architect's Journal.

MEMOIR ON THE PRACTICABILITY OF SHORTENING THE DURATION OF VOYAGES BY THE ADAPTATION OF AUXILIARY STEAM POWER TO SAILING VESSELS. *By* SAMUEL SEAWARD, *F. R. S., M. Inst. C. E. From the Transactions of the Institution of Civil Engineers.*

The fearful expense which has been found to attend the extension of steam navigation to voyages of extraordinary length appears to constitute an insuperable obstacle in the present state of the steam-engine to the beneficial establishment of lines of uninterrupted steam intercourse between distant continents. The imperfect success which has attended the developement of the several enterprises which had for their object the maintenance of a steam communication between Great Britain and New York, is a proof of the difficulties which wait upon the performance of long steam voyages, and furnishes a lesson which will not be readily forgotten by future speculators. The successive disappearance of the Sirius, Royal William, Liverpool, United States, British Queen, etc., from the Atlantic station, proclaims with a voice as authoritative as that of a messenger from heaven, that the Atlantic enterprise has been a failure, and that a perseverance in its prosecution, *under the same circumstances* which drove those vessels from the field, can only add energy to ruin and flagrancy to guilt.

For several years past the project has been in contemplation to adapt steam power to sailing vessels, in such a manner that it may be used to discontinue at pleasure, and it is the object of the author of the work before us, to recommend the extended adoption of steam power in sailing ships, as being productive of the most prominent of the benefits which steam navigation confers, without entailing any serious expense for the maintainance of its operation. A good ship, when impelled by a favorable wind, will realize a velocity which few steam vessels are able to surpass, and it is only in calms, or when the wind is adverse, that the peculiar powers of a steam vessel are productive of benefit. It becomes a question, then, whether it would not be advantageous to so adapt steam power to sailing ships as to be only used in calms, or in adverse circumstances of wind and water.

In order to form any comparative estimate of the benefits of this proposed application of steam power, it is necessary to refer to the circumstances which attend the voyages of sailing ships and of regular steamers upon the open sea. In some of the lines of intercommunication between distant countries, vessels are exposed to strong periodical winds or protracted calms, while other lines are distinguished by winds which sweep across the ocean in one direction for nearly the whole year. In calms such as those that prevail about the line, and by which vessels on the route to India are often for a long period detained, a small portion of steam power might be most beneficially employed in transporting the vessel from the region swept by the current of wind which flows from the pole towards the equator, into the locality of those land and sea breezes which enable the vessel to continue her voyage; but the same proportion of steam power would be perfectly unserviceable in propelling a properly rigged ship against a strong adverse wind. For such a service a proportion of power to tonnage similar to that observed in our fastest steamers in indispensable, and it is only therefore in voyages where calms are likely to be met with that adaptation of auxiliary steam power to sailing ships can be productive of benefit. Upon the superior economy of vessels supplied with auxiliary steam power, Mr. Seaward makes several very sensible observations:—

"A most material circumstance affecting the utility and economy of steam vessels of great power, is the space necessarily occupied by the engines and the supply of coals, which are found to require three-fourths of the whole area below deck, leaving only one quarter for the stowage of cargo; and that, owing to the great weight of the former, must principally consist of measurement goods. Thus the "President" and the "British Queen," although of 2000 tons register, have never been able to carry more than 500 tons of measurement goods as freight.

"From a due consideration of these features of the question, with respect to the expediency of employing large steam vessels (and it is believed that few practical men will dispute the facts by which they are developed,) it is evident that the attempt to perform voyages of lengthened duration by the power of steam alone must, in the present state of engineering science, be attended with an expense wholly disproportionate to the profits.

"The present state, therefore, of steam navigation is evidently altogether inadequate to meet the large and daily increasing demand of commerce; and in this respect, as far as maritime navigation (as contra-distinguished from river and coast navigation,) is concerned, steam must be considered to be in its infancy, for the communication by this means with our own or with foreign distant colonies—India, *via* the Cape of Good Hope—the West Indies—

the pacific Ocean—Australia—the Brazils, and other highly productive countries, is at present impracticable to any extent, as the facts hereafter stated will more distinctly show.

"Before entering upon the details of this scheme, either as regards its past success in the partial and limited application which it has hitherto received, or as to its future adaptation, it may be desirable to describe the class of sailing vessels to which auxiliary steam may be regarded as an applicable power, and where its employment may be expected to be attended with success; and here it must be observed, that commercial and not scientific success is the result looked to, for nothing can be considered succesful in a commercial point of view, to which a fair profit upon the capital employed does not attach."

The definition of the term "success" here given might be looked upon as unnecessary, had we not before us the rememberance of the strange perversion of the plainest language, during the discussion of the Atlantic steam enterprise. In that case success was regarded as synonymous with practicability.

Mr. Seaward informs us that auxiliary steam power is beneficially applicable to all vessels, from 400 tons upwards, and that the proportion of one horse power to 25 tons will propel a vessel in a calm at the rate of 5 knots per hour. He then institutes a comparison between the time occupied by the ship "Vernon," fitted with auxiliary steam power, on her voyage from London to Calcutta, and that of the steam ship "India' which performed the same voyage about the same period. The expenses attendant on the employment of auxilary steam power in the "Vernon" duriug this voyage are stated to have been £600; whilst the expenses attendant on the "India" for the same period are estimated at £4293, showing an excess of expenditure over that of the "Vernon" of £3693. The comparative rate of the vessels in point of speed, as stated by Mr. Seaward, appears by no means favorable to the "India;" but, as we know the "India" to have been detained for a considerable period at the Cape by stress of weather, and as we conceive there are evidences of some slight prejudice against the "India" in consequence, we presume, of her being a Clyde built vessel, we attach but little value to this part of the statement.

Mr. Seaward's memoir contains much important information, and manifests a familiar acquaintance with the subject of which he undertakes to speak, and the possession of a liberal share of good common sense. It is also well written, though we should have been better pleased with it had there been less straining after rhetorical decoration; a serious fault in any paper which professes to treat of practical and scientific subjects, especially when addressed, not to the herd of mechanical amateurs, or scientific cyphers, but to an association of able and practical men. Another fault which pervades the work, is the frequency of reference to and of involved commendation of, the Messrs. Seawards' engineering performances. We hear a great deal too much of the excellencies of the "Gem" and the "Ruby," and we find those vessels and the "Brunswick," the latter a work also of Messrs. Seaward's and a comparative failure, associated with and obtaining the precedency over the "Eclipse," the "Blackwall," and the "Railway," vessels by which, in point of speed, they are entirely outstripped. Such preferences as these manifest an unbecoming partiality, as ill-judged as it is impotent; and are equally unworthy of those by whom such communications are accredited as of those by whom they are rendered.

In conclusion, Mr. Seaward observes that he has avoided all recondite calculations, with a view of meeting more effectually the objects of practical men. He further informs us, that theoretical calculations upon such a subject as that he has undertaken to handle, however suited to the philosopher's study, are of little value to the practical engineer or ship builder; and he quotes the language of the late President of the Institution of Civil Engineers, to the effect that, what is wanted for that society is the developement of that knowlendge which is founded upon practical experience. From this intimation we might infer that, in the opinion of this gentleman, science is incapable of rendering any aid to the practical mechanist, but that he would be prepared to go into the most recondite computations, were such a course desirable. In reference to the first allegation, it is only necessary to observe that, in the developement of that knowledge which is founded upon practical experience, science is the most efficient instrument; in proof of which fact, we might refer to the extraordinary developement the arts have experienced since their progress has been aided by the light of science, as compared, with their station and condition when they were merely empirical. As regards the second implied allegation, namely, that Mr. Seaward would be prepared to enter into extremely recondite calculations respecting the subject of his memoir, except for the weighty reason he has given, we can only admire the discretion which dictated so much forbearance. If it be Mr. Seaward's desire to maintain his reputation for profundity, he will best accomplish his object by avoiding all attempted manifestation of it. The only attempt of this description in the memoir before us is in the 4th page, where we are told that "the employment of a quadruple amount of steam power would not double the speed, although in theory this is assumed to be the fact." By whose theory is this assumption made? We presume that it must be of Mr. Seaward's own fabrication, and his exclusive property, it being the theory of other engineers that the resistance increases as the square of the velocity, and the power necessary to overcome that resistance, as the cube of the velocity. And the reason is obvious. If the power be doubled, the resistance, is quadrupled; the force of the engine, therefore, to overcome this resistance, must be quadrupled also, and must act with a double speed. In other words, when the speed is doubled, the power requisite to maintain that speed has to be increased eight times instead of four times, as by the *theory* of Mr. Seaward.

[From the Civil Engineer and Architect's Journal.]

REPORT ON THE GAS FURNACES USED IN THE IRON WORKS OF WASSERALFINGEN, *By* M. H. SCHOENBERG.

ONE of the most important modern improvements in the manufacture of iron we owe to M. Fabre Dufaure, Mining Counsellor, Director of the iron works at Wasseralfingen in Wurtemburg, who has succeeded in collecting the gases which are formed in blast furnaces, which constitute the flame which escapes, and to use them in the refining, puddling and balling furnaces.

The use of the furnace flame for several purposes, as warming the air used for the blast, roasting lime and ore, making coke, and heating steam engine boilers, has been known these seven or eight years. It has not, bowever, been hitherto practicable to produce a higher temperature than red heat. which was a limit to its application ; by M. F. Dufaures's process any degree of heat required can be obtained. The principal distinction of this method is the mode by which the gas is burned, by the introduction of atmospheric air supplied by bellows, and in the ingenious construction of the furnaces and fire-places.

At Wasseralfingnn there are now three furnaces worked by gas, but the refining furnace is supplied from the southern blast furnace alone, which is done by simply introducing a tube to a certain depth in the fire-place of the blast furnace. It appears that about a sixth or fifth of the gas evolved is collected by this method; and notwithstanding this substraction, no diminution is observed in the power of the flame which escapes. In the refining furnace there are thus produced 175 metrical quintals of fine metal, partly with a radiated crystallization, and partly with a ball-like structure, but all of a silver white. The gas refining is so complete, that the iron is produced highly decarburretted, and freed from all impurities among others, from phosphorus and sulphur. The waste which in common English refining is never less than trom 9 to 10 per cent., is not more here, when the furnace is in good order, than 1 to 2 per cent; and by this process a greater quantity of fine metal is obtained than if pig iron had been used. It is to be further observed, that the pig iron passed through the furnace here consists only of castings, which, as is well known, often contain a good deal of sand mixed with them.

The operation is so well arranged, and proceeds with such uniformity, that it rarely meets with those casualties common in the usual process of refining, while the cost of manual labour is also less.

The results of puddling by gas are not less satisfactory. The puddling furnace at Wasserelfingnn is supplied with gas from the northern blast furnace, into the fire-place of which are plunged two suction pipes, by which enough gas is collected, to work a puddling furnace and a refining furnace ; but the power of the water-wheel which works the blast apparatus not being great enough, these works can only be supplied alternately. The temperature of the puddling furnace is, from the nature of the process, higher than that of one fed with wood, coal, or turf; the flame also is clearer and transparent, so that the workman can easily watch the operatiion, and carry it on regularly. In each of these operations the furnace is charged with $1\frac{3}{4}$ or 2 metrical quintals of fine metal, previously heatedto a red heat by another furnace; and at the end of an hour and three quarters, or two hours, the effect is produced.

The waste of fine metal in this process is very small. being only from 1 to 2 per cent. The quality of the iron is excellent. A feature peculiar to gas puddling is that the formation of slag and its reduction goes on spontaneously, so it is never thrown away. The produce of the puddling furnace is 125 metrical quintals per week.

The operation of refining in the gas furnace has, like the preceding, considerable advantages; but the results have not yet been so important as in the preceding cases, and the quantity of waste is still considerable. The draught of the furnace is good, and the temperature sufficiently raised; so that, unless an accident occur, the produce is 150 metrical quintals per week.

From what has been already said, it will be seen that the results of the gas furnaces at Wasseralfingen are most satisfactory. Even with castings and rubbish, bar iron of excellent quality is produced, with a waste of not more than from 12 to 15 per cent., and without the consumption of any costly fuel, or rather by making use of a combustible matter, which hitherto has not been turned to account,

Belgium is the only country in which M. Fabre Dufaure's process has not been introduced, while in other places it has been extensively used. In England, at Messrs. Hill's works, at Merthyr Tydvil; in Germany, at the iron works of the King of Bavaria, Grand Duke of Baden, Princes of Fustenburg and Sigmaringen, Duke of Anhalt, the Saxon Iron Company, Count Einsiedel in Prussia, &c.; in France, at Lucelle; in Hungary, at the works of Count Andreasky and M. Inglo; in Russia, at those of the Prince de Bukna and Count Malzon; in Sweden, at Mr. Ekmann's; and in Italy, at the works of Dorgo, on the Lago di Como.

At one of the meetings of the French Institute, M. Dumas read a letter from M. Grouvoelle, giving some further particulars not contained in M. Schoenberg's report, as to the process used by M. Fabre Dufaure in the iron works at Wasseralfingen. The practice is to carry into the refining furnace the pig iron delivered from the high furnaces, and not cold iron, as is usually done. The object is to save the caloric employed in the fusion. The puddling furnace produces 10,000 kilos, or about $9\frac{1}{2}$ tons of iron per week. At this time a third blast furnace is being constructed, and steam engines are being put up, to work the gas on a large scale. M, Fabre Dufaure's experiments began in 1837, and took place on refining cast iron; and the processes used by him at Wasseralfingen were kept secret until the present time, by desire of the King of Wurtemburg, who was unwilling that they should be known immediately in other countries.

After making this communication M. Dumas reminded the Academy that he had received about two months ago specimens of iron obtained in France by gas puddling in blast furnaces, by means of the process adopted at the iron works of Treveray, by the proprietors, Messrs. D'Andelarre and Lisa, and by the engineers, Messrs. Thomas and Laurens. He added, that the puddling furnace set up at Treveray has worked very well, and has already sent produce into market. In this furnace is refined iron, which is produced in the same way as in the common puddling furnace used in Champagne. The gas of a single blast furnace producing 5 cwt. of iron per day is enough to feed it; a result which proves that all the cast iron produced may be converted into bar without further fuel, while such a result cannot be deduced from the work at Wasseralfingen, where the quantity of iron produced even at present is much smaller than the quantity of cast iron afforded by the two blast furnaces at these works. M. Cumas states the advantage of the Treveray gas plan to be an improvement in the quality of the iron, which has the properties of charcoal iron, a considerable diminution of waste, and a great saving of fuel. It is to be further observed that no effect is produced on the blast of the furnaces from the shafts in which the gas is collected. M. Dumas remarked to the academy a passage in M. D'Andelare's letter, that the idea of using combustible gases for the same purposes as other fuel had been long since suggested by M. Thenard, in his public lectures; and the importance of these processes, which promise much, lies principally in the apparatus, which has enabled them to be successfully used.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.—INSTITUTION OF CIVIL ENGINEERS.

"*Description of a portion of the works of the Ulster Canal,*" By THOMAS CASEBOURNE, *M. Inst. C. E.*

The Ulster Canal, which is described in this communication, was designed for the purpose of facilitating the intercourse between the west and the north of Ireland. It commences at the southern extremity of Lough Erne, in the county of Fermenagh, whence it extends 46 miles, and enters the river Blackwater, near the village of Charlemont, in the county of Armagh, from which there is an outlet through Lough Neagh to the ports of Newry and Belfast. The total cost of this work will amount to about 210,000*l.*, or about 4,565*l.* per mile. Allusion is made to proposed junction canal between the rivers Boyle and Shannon, which may be considered as an extension of the Ulster Canal westward, effecting a junction between all the navigations of Ireland. By its means the produce of the town of Boyle, and the agricultural districts around it, would be conveyed directly by steam to Belfast and Newry. At the time of this communication, the Ulster Canal was rapidly advancing towards completion; it was navigable up to Clones, a distance of 40 miles from its commencement, and would be opened to Lough Erne during the summer of 1841. A description is given of the most difficult and expenisve portion of the canal, which is situated at about six miles along the line from Charlemont. The length of this part is about three-fourths of a mile, and it comprises seven locks. The expense of construction, exclusive of the value of land, was 17,053*l*. 4*s*. 9*d*.; in order to diminish the expense as much as possible, the canal was contacted in width in two points, where the local impediments were considerable. The transverse dimensions of the canal are, 19 ft. 6in. at the bottom, 36 ft. at the surface of the water, and and 42 ft. at the top bank—giving a slope of 3 ft. 2 in. at the sides of the channel. The depth of water is 5ft. 6 in. in all the reaches, except the summit level, which is capable of containing 7 ft. of water. The course of this portion of the line lay along the bottom of a steep ravine in a limestone rock, parallel with the channel of a millrace adjacent to the river Blackwater. The mill-race was, therefore, diverted into the river between the first and fifth locks of the canal. Between the third and fifth locks the bed of the canal was formed by blenching the rock on one side, and embanking on the other with the materials so obtained. Beyond this it was cut for a distance of nearly 350 yards through the limestone; in one place to a depth of 41 feet. The sides and bed were then lined with puddle, and protected by a forcing of rubble wall. Thence to the seventh lock, the channel was again formed by benching and banking through a clay soil, where much caution was necessarily exercised in preventing slips at the foot of the embankment, which was subject to inundations from the Blackwater. The masonry was all constructed of limestone from an adjacent quarry. Two appendices are subjoined to this paper. The first of these gives in detail the items of expenditure for the portion of the canal described; the second contains a particular decription of the locks and lock-gates, the bridges, and the earth-work. The locks are 73 feet long, 12 ft. wide, and vary in rise from 6 to 11 feet. They are all constructed in ashlar masonry. —The paper is accompanied by three drawings, descriptive of the general plan and the details of these works, which were originally designed by Mr. Telford, and are now under the direction of Mr. Cubit. They have been executed almost entirely under the superintendence of the author.

An account of the Permanent Way of the Birmingham and Gloucester Railway. By G. B. W. Jackson, *Grad. Inst. C. E.*

The object of this railway is to afford a direct communication between the western and the midland counties of England. The communication describes the course of the line until it reaches Cheltenham, where it joins that which was formerly called the Great Western and Cheltenham Railway, which terminates at Gloucester.

Its length is 54 miles. The prevailing inclination is 1 in 300; but on the "Lickey" incline, near Bromsgrove, the rise is 1 in 37 for a distance of 2½ miles, in ascending which the trains are worked by American locomotives, in addition to the usual train engines. The northern portion of the railway appears to lie on the new red sand stone; then passes to the oolitic formation, on which it terminates.

In the former, the principal cuttings are through marl, some of which is exceedinly indurated and troublesome to work. The principal strata of the latter system are blue and yellow clays. Near Cheltenham, the shifting sand frequently necessitated the use of sheet piling in passing through it. The waters of Droitwich and Cheltenham were found to possess a saline quality, which rendered them unfit for the use of the engines. That from the surface sand near Cheltenham, however, is exceedingly good.

The building materials employed on this line were—the sandstone of the Lickey and Forest of Dean, the lias of Norton and Wadborough, and the oolites of Cheltenham and Bredon, together with brick, for which earth was readily procured throughout. The cuttings and embankments, with the details of the permanent way, are severally described. The surface width is 30 feet. In the formation of embankments and cuttings, the usual methods appear to have been adopted. In the former, the ratios of the slopes vary between 3 and 2½ to 1; in the latter, between 2 and 1½ to 1. In cuttings, there is a system of drainage beneath the ballast, consisting of longitudinal drains on either side of the line, connected by cross spits, all of which are filled up with broken stones The rails are supported by chairs and intermediate saddles, which rest on longitudinal balks; and these are bolted to transverse ties. On embankments whost height exceeds five feet, the cross spits, longitudinal balks, and saddles, are dispensed with. The length of the bearings, the weight, dimensions, etc., of the iron and wood work, with the manner of putting together the whole, are then noticed. The timber employed was American pine, and English beech, or larch. The various prices are enumerated of the materials and labor for the permanent way, of which the average cost per mile amounted to 5,430*l.* The present conditon of the line is stated to be good, and its general working to have been perfectly satisfactory, since its opening in June, 1840.

Subjoined is a description of an artificial ballast obtained by burning clay, which was employed when the country did not afford natural ballast. Its expense slightly exceeds that of the ordinary ballast; the blue clay burnt in kilns was found to answer the purpose best, but it does not appear to form a successful substitute for gravel. The results of experiment show it to form a very imperfect drain. The author states that he has always observed the quality of this ballast to suffer in proportion with the quantity of lime contained in its composition.—The paper is accompanied by four drawings, illustrating the construction of the permanent way.

ON THE APPLICATION OF WATER TO ANTHRACITE.

All persons who have been much accustomed to the use of anthracite for fuel seem to entertain an idea that the application of water has a beneficial effect. It is the invariable custom of the old inhabitants of the districts where no other fuel is used, to wet the coal before putting it on the fire. A wet paste of small culm, mixed with clay, makes a more lively and pleasant fire than small coal alone.

This must arise from the clay retaining a portion of the water until decomposed by the ignited carbon of the coal producing the gases, carbonic oxide and carburetted hydrogen. It has been suggested that the application of vapour of water to anthracite fires in steam boilers would supply the gaseous or volitile proerties of Bituminous coal; there is, however, much difficulty in the perfect developement of the principle, arising from the compact structure of the coal, and the close manner in which pieces of coal saem to adjust themselves in the fire. It is necessary that the coal be kept in an active state of combustion while the vapour is passing through, but so little passage being allowed through the fire, when the vapour of water is applied, it shuts off the supply of air, consequently the combustion is diminished. It requires both a very high temperature and a large quantity of pure air, with a full *quantum* of oxygen, to consume carburetted hydrogen—the most important of the two gases. Carbonic oxide burns at a very low temperature, and produces little heat. A quantity of flame may easily be produced by steam passing through an anthracite fire, but it is chiefly that of the latter gas, the former being volatilized without burning, and its powerful effect, consequently, lost. Besides the air necessary to keep up the combustion of the coal in the fire a large quantiy is necessary to consume the gases, and that too, at a high temperature. It appears impossible to to attain these results with a common draught.

The writer, after considerable experience, is decidedly of opinion that anthracite cannot be used with advantage in ordinary boilers without a blast. When a blast is used, although it may be difficult yet it is not impossible to devise a method of producing the full effect from the application of water to an anthracite fire; it is a subject of vast importance, and well worthy the attention of young mechanics and engineers—a fine field for the exercise of their ingenuity. It is quite certain that some anthracite contains ninety-five per cent. of pure carbon, and were it possible to render the entire effect of this available, certain portions of it converted into volatile inflammable matter by its union with the elements of water, and steadily and continuously applied to the tube or flues of a boiler without loss anthracite might be considered as a species of concentrated fuel—an invention of incalculable value for steamers going upon long voyages. When anthracite is used for blacksmith work, there is abundance of heat, but a large quantity of cinder is formed; this cinder has generally been considered as a mere oxide of iron, but it certainly contains carbon. It is the same cinder which is produced in large quantities in the refining process of iron works. Possibly oxygen and carbon, in the proportions to form carbonic oxide, are combined with the iron. A minute quantity of water running into a blacksmiths fire, when using anthracite, would remedy this —the presence of hydrogen preventing, in a great measure, the formation of the cinder. It is an axiom in the north of England, that a good gas coal is a good smith's coal, and *vice versa.* It will be quite impossible to manufacture malleable or bar iron of good quality, using anthracite for fuel, without the application of the vapour of water. This is a subject of the deepest interest to parties embarking in iron-works, where anthracite must be used for fuel. A patent for producing gas, by passing steam through a retort charged with anthracite, has been taken out by E. O. Manby, Esq., C. E., of Swansea—a gentleman possessing a thorough local knowledge of the anthracite district of South Wales, and who has had the best opportunities of judgeing of the powers and capabilities of the coal. He produces gas of great illuminating power rapidly and abundantly, which requires no purification. It seems likely that the distinguishing feature in the difference of the several varieties of coal depends upon the presence of the elements of water, either entire or in varying proportions, that are combined with the carbon—anthracite being quite free from them. It is a fair speculation to imagine that the anthracite veins of coal at some period possessed bituminous properties, but that being more immediately acted upon by volcanic commotion, all volatile matter was expelled, while extraordinary pressure being applied left the coal a solid compressed mass of carbon, constituting the peculiar characteristic of anthracite.—*Mining Journal.*

ACADEMY OF SCIENCES.

Feb. 1.—M. Ebelman read a memoir on the nature of the *various vapours developed in smelting furnaces*, as observed at different altitudes within the furnace. The object of ruch researches was to determine the degree of heat at various points, and to devise means for the improved regulations of the fires. He has arrived at the following results.—1. The gaseous vapours, on coming out of a furnace heated by charcoal or wood, contain watery vapour, corbonic acid, and oxides of hydrogen and azote, but no carbonated hydrogen. At 6 or 8 feet below the mouth of the furnace the watery vapour is not found, and the proportion of oxide of carbon increases, while those of hydrogen and carbonic acid diminish, according as the observations are made lower and lower down in the furnace. 2. When coal is used jointly with wood for heating the furnace, the carbonization of the vapours takes place in an internal zone, and the water is expelled from the metal at a very low altitude. He found that the proportion of gas which traverses a certain zone of the furnace per minute, is greater according as it is further from the bottom of the furnace.

The Minister of Commerce communicated to the Academy some observations from the Industrial Society of Mulhausen on the importance of adopting an unit of measure for the force of machines, considered not only in the power exerted, but in the time required. The Society observed, that the usual estimation of horse power was not uniform, and proposed that the unit of France should be the force required to raise one kilogramme to the height of a metre in a second. To this unit they proposed that the name of *dyne* from the Greek root, signifying "moving force," should be applied, and then that it should be compounded with Greek and Latin words, in the same way as the metre, the gramme, etc. Thus the *kilodyne* would signify a thousand times this unit, and the *millidyne* would signify the thousandth part of the same unit.

M. Arago read a communication from M. Rusiger a German geologist, on certain geometrical observations, made in order to ascertain the relative altitudes of the Dead Sea, in Palestine and the Mediterranean.

It appeared not only that the surface of the Dead Sea was 219 toises, or about 1,314 feet lower then that of the Mediterranean, but also, from the geologicl phenomina observed on its shores, that the formation of the basin in which it lies was antecedent to all historic epochs. Hence the supposition that the sea was formed by the sinking of the plain on which the cities of the Pentapolis, (Sodom, Gomorrah, etc.) were situated, is incorrect. M. Arago added, that the observations of M. Berton, a French engineer, made the depression of the Dead Sea below the Mediterranean 419 metres, or 1374 English feet.

Atmospheric Railway.—The report on this subject of Sir F. Smith, R. E. and Professor Barlow, has been presented to Parliament. The summary of their opinions is thus given: "1. That we consider the principle of atmospheric propulsion to be established, and that the economy of working increases with the length and diameter of the tube. 2. That the expense of the formation of the line in cuttings, embankments, bridges, tunnels and rails, will be very little less than for equal lengths of a railway to be worked by locomotive engines, but that the total cost of the works will much greater, owing to the expense of providing and laying the atmospheric tube, and erecting the stationary engines. 3. That the expense of working a line on this principle, on which trains are frequently passing, will be less than working by locomotive engines and that the saving thus effected will, in some cases, more than compensate for the additional outlay; but it will be the reverse on lines of unfrequent trains. However, there are many items of expense of which we have no knowledge and can form no opinion, such as the wear and tare of pistons, valves, etc.; on these, further experience is needed. 4. That with proper means of disengaging the train from the piston in cases of emergency, we consider this principle as regards safety equal to that appertaining to rope machinery. There appear, however, some practical difficulties in regard to junctions, crossings, sidings and stoppages at road stations, which may make this system of less general application."

Brick-making, etc.—A discovery has been made by Mr. R. Prosser of Birmingham, which bids fair to be attended with important results to the interests of architecture. The novelty of Mr. Prosser's process consists in the clay being dried, ground to powder, and submitted to pressure in metallic moulds until the particles cohere together. As there is no water in combination with the clay, no drying process is necessary; consequently the articles made by this method are ready to be fired or burned as soon as they leave the machine. Owing to the great pressure required to cause the particles of clay to cohere together, the articles made by this press have greater density than those made in the ordinary way; they are also less porous, and not subject to decay in wet or frost. In addition to these advantages, any architectural device may be impressed upon the clay, which. when burnt, will retain all the sharpness of the original, however elaborately finished. By this process bricks may be made in all weathers, and with greater economy than by any other plan known at present. The brick-press is worked by hydraulic pumps, giving about 300 tons pressure, thus producing the adhesion and cohesion. The machine delivers the brick (four at a time in the present machine) ready at that instant for the kiln, requiring no exposure to the atmosphere to dry. The whole operation, from the time of putting the powdered clay into the machine to the delivery of the brick, occupies about half a minute. Machinery might readily be constructed to produce bricks fifty a minute.—*Daily Paper,*

Flour Transportation by Railroad.—The following note to the directors of the Western railroad, show the result of actual experiment in the transportation of flour from the west by railroad. —*Troy Whig.*

No. 23, Long Wharf,
Boston, May 25, 1842.

Gentlemen: Having received several parcels of flour over the Western railroad, it gives us much pleasure to state that they came in excellent order, without waste, and with great despatch.

In our judgement, the road answers the expectations of its warmest friends, so far as the transportation of flour is concerned. At the present price of freight, 32 cents per barrel for flour, the cost by railroad is only *one cent* per barrel more than the freight by packets, thus:

Freight by packet from Albany, - - -	25	cents.
Insurance at $6 per barrel half per cent, - -	3	"
Wharfage in Boston, - - - - - - -	2	"
Interes on $6 per barrel, allowing a passage of 10 days,	1	"
	31	per bbl.

You will doubtless find the receipts of flour over the road increase weekly, and when the new crop of wheat (which is very large) comes to market, you will find your warehouse, large as it is, barely sufficient to accomodate the immense quantity of flour which will seek a market in your city,

We are very respectfully, yours,
E. Williams & Co.

Signor C. Ghega, the Austrian Engineer.—The distinguished and accomplished Signor Ghega, so well known in Europe as the founder and constructer of the railroads of Germany and Austria, and who was dispatched to this country by the Emperor to examine and report upon American improvements in locomotion, nearly accomplished his extensive tour through the United States, and has expressed himself in the highest terms of admiration of our astonishing advancement in the art. His judgement fully confirms the claims made by our engineers to a superiority over the British in locomotive machinery. Some of our engines, in which the latest improvements have been introduced, he has pronounced immeasurably in advance of all others in the world.

Signor Ghega has inspected all the principal lines of railroad, and has been industrious in Philadelphia, Baltimore, Washington, New York, Boston and Albany, in making plans and calculations with which he is about to return richly freighted to Europe. He is now completing his survey of Lake Erie, and will sail in time to meet the Archduke Frederic at Venice before that Prince embarks on his promised voyage to this renowned republic. This young Prince, who is described as a highly amiable and accomplished gentleman, would doubtless be received here with all the courtesy and attention that was paid to the Prince de Joinville, and is expected to arrive here in the Austrian frigate Venus in the beginning of September. And we are as gratifind to know, as Signor Ghega is warm in acknowledgeing, that he has every where been received with as much kindness, hospitality and respect as could have been shown to royalty itself; and this intercourse of eminent foreigners with our country, cannot fail to extead our good name and fame throught the civilized world, and greatly redound to our commercial and intellectual advantage.

German Railways.—The Prussian State Gazette publishes a long article on the railways of Germany, the result of which is the division of all the lines of railway into the following:

Miles finished - -	$175\frac{1}{3}$	which have cost	$28,940,000
Miles in course of construction - -	$166\frac{1}{3}$	which will cost	43,357,000
Miles determined on -	$124\frac{1}{4}$	estimated at	27,240,000
Miles projected - -	363	proximate estimate	30,586,000
Miles, lines of junction -	193	" "	42,846,000
Total number of miles, -	1,022	Cost - -	$172,969,000

The Leipsic Gazette, on the other hand, announces that the Austrian Government has decided on authorizing the construction of a railway between Vienna and Dresden, by the valley of the Elbe. It is expected that all possible favor will be conceded to the plan, and that there will ever, be the guaranty of an interest of 4 per cent.

Steam Power as a Bond of Union.—We see the results of the emplyment of this element as a means of consolidation in our own country; composed as it is of so large an extent of territory, filled with such a mass of discordant materials, and so many conflicting interests. Steam power binds the whole together in a compact mass; and but for the application of this power, the union of the twenty-six States would not last twenty years. And so it is with the consolidation of the energies of the British Empire. The political union depends upon the social union; the intermingling frequently and at the most remote points of the social, political, and commercial elements of the whole nation. And nothing which can be brought to bear upon the energies of a nation, binds them so thoroughly together as the application of steam power, and its elements, to every ramification of the social and political system.

Central Railroad.—We are pleased to learn from a gentleman who visited most of the work beyond Oocanee, a few days since, that the contractors are pushing on with their work, with all possible speed. It seems that the suspension of the Railroad Bank has not operated so seriously against the interest of the Company, as its enemies had hoped. The public knows the cause of this suspension. No mysterious circumstances are connected with it. No schemes of speculation brought it about. The available means have been expended in constructing a railroad connecting our princpal seaport with the very heart of the state, thus bringing to our doors a convenient market for our produce, and where we may purchase our groceries on better terms than heretofore. The people in view of these things will certainly do all in their power to sustain the bank. We are truly glad that the contractors are pressing on with the work with all possible speed, evincing thereby, their confidence in the bonds of the company.

Locomotive and Train stopped by Worms.—The Charleston Patriot contains the following remarkable story.

On the completion, a few days since, of the railway, on the Tressel and Bridge over the Congaree Swamp, and river, a general migration of the Caterpillars of richland, took place towards the St. Mathews shore. An army of worms, occupying in solid column, the iron rail for upwards of one mile, presented, as was supposed, but a feeble barrier to the power of steam. A locomotive with a full train of cars loaded with iron, and moving at a speed of from ten to twelve miles an hour, was arrested, notwithstanding at midway in the swamp by these insects, and through the agency of sand alone, freely destributed on the drawing wheet, was it able to overcome them. It was a sanguinary victory in which millions were crushed to death; though the caterpillars maintained their ground and enjoyed a triumph in resting for a brief period, even the power of the locomotive.

Among the strange craft that navigate the Ohio, is a floating glass manufactory. A large flat boat is filled up with a furnace, tempering oven, and the usual apparatus proper for such an establishment. It is in full blaze every night, melting glass ware, which is retailed all along shore, as the establishment floats down stream. It hails from Pittsburg, and is owned by Ross & Co.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 12, Vol. VIII. New Series. | JUNE 15, 1842. | Whole No. 408. Vol. XIV.

The present number concludes the eighth volume of this Journal and the tenth entire year of its publication. Of the value of the matter contained in the work we do not at present intend to say any thing; that it *might* have been greater we will not deny, but we can safely declare that under existing circumstances we have done all that could have been done. It must be remembered however, that the means of conducting and giving value to any periodical, but particularly to one of a technical or scientific character are directly dependant upon the encouragement it receives, and this encouragement does not exist alone in reading the work, for which however we return our best thanks, but in a more substantial return for value received.

As all our readers are acquainted with mathematical language we may make ourselves better understood by stating the fact above mentioned in the form of an equation.

Let I represent *one* or each individual who takes the Journal.
Let V represent a good current five dollar bill or its equivalent:
Let x represent the number of those who send us V each year:
Let y represent the number of those who do not send it.

Then $x\,\mathrm{I\,V} + y\,\mathrm{I}\,0 =$ the encouragement we receive $=$ E

but $y\,\mathrm{I}\,0 = 0$*

$\mathrm{X\,I}x + 0 = x\,\mathrm{I\,V} = \mathrm{E}$

* There are some cases in which I must be affected by a coefficient, representing the number of years in arrears, but as the result is 0 it does not alter the value of E, and would only render the equation more complicated.

The quantities x and y being unknown it only concerns each individual to recollect that "*I* must send V."

The next number of this Journal will contain an announcement of the arrangements which have been made to give increased value to its pages and to obtain the co-operation of the most distinguished writers and laborers in the cause of internal improvement.

We cannot but think that the durability of rolled rails has been too hastily called into question. Well rolled iron is not subject to exfoliation by the simple action of rolling, however long continued, and when this effect is observed, it will be found to result from a want of homogenous structure in the iron—or in other words, from an imperfectly wrought metal, as our correspondent has properly observed. Any defect in the original piece of metal is merely extended by the subsequent rollings, and although deficiency in the manufacture may thus be concealed, this will not fail to become manifest after a while. It would surely be folly to abandon the use of rolled iron, because in a very few cases, it has been found defective.

But there is the advantage in favor of rolled iron, that its defects if any are extended longitudinally, over the bar, forming a sort of fibre, and but little impair the transverse strength, while cast iron bars are liable to defects in a transverse direction, giving rise to more sudden failures and productive of more serious consequences.

Another thing to be taken into consideration is, that from the infancy of the science of railway structure, the mode of joining the rails and adapting their ends, generally very imperfect, has given rise to inequalities of surface, elevating the end of one rail and depressing that of the other, thus producing an obstacle injurious both to the engine, the cars, and to the rails. Whenever this has taken place, a rounding off may be seen on the end of the rail, and it is here chiefly that what is called exfoliation may be observed, and only in a very slight degree. The removal of this difficulty, however obvious, need not be considered in this place as it equally concerns both kinds of rail.

[For the American Railroad Journal and Mechanics' Magazine.]

DURATION OF RAILWAY IRON.

I have perused an able article relative to the *duration of iron railways,* in your last number, and I cannot but express my surprise at the opinion uttered by Mr. Ellwood Morris, to wit: "*that rolled iron edge rails, of the T and H forms, will not endure more than ten years.*"

In the first place, we would state that our experience both in this country and in England, with the edge rail, does not extend over a period to exceed eight years. It being generally understood, that the credit of this improvement is due to an American, Col. Stevens of New Jersey, who rolled the first edge rails, on a visit to England for this purpose, 8 years ago, and then introduced them into this country by their application to the Camden and Amboy railroad. Thus far we have no account of their having failed in the least. With respect to the flat bar, the experience, both in this country, and in the coaleries of England where iron railways have been in constant use for twice ten years, an entirely different result is found.

It is true, as remarked by your correspondent, that much depends on the ore from which the iron rails are made. Then again, as to the perfection in the working of the ore, the quality of the iron, if hard or soft, prior to the rolling of the bars. Much rolled iron has been palmed off on us, that hardly deserves the name of iron.

An instance of defective iron is presented in a portion of the "fish belly" rail, pattern on the New York and Harlem railroad.—This iron is of a coarse and imperfect quality. Yet, this flat bar has sustained the wear of very ill constructed four wheeled cars, every 10 to 30 minutes during the day for near ten years, and has conveyed some 7 or 8 millions of passengers. The only wear perceptible, is at the junction of the bars. This has occurred mainly from the sledge hammer action of these cars with four wheels in the centre, distant from the ends of the cars. The cars being thrown ont of balance, or on a tilt, by the irregular distribution of the weight of the passengers often standing on the projecting platform of the cars, to enjoy the pleasure of their cigars, while the draught of the horses on the tilt gives a regular pounding motion. At the junction of the iron rails we find them bruised and often exfoliated. This more frequently occurs where the granite longitudinal sills, (now generally abandoned,) serve as the anvil for the wheels to bruise the ends and thus to test severely its endurance.

But, to prove that the transportation of one and a half or two millions of tons over an edge rail will not ruin any road, we will give a quotation from de Pambour, furnished us by a professional friend, (page 286) where it is shown, "that in the year ending 1st July 1834. 515,252 Tons gross, not including the weight of the engines and their tenders, passed over the Manchester and Liverpool railway," and (page 287) "558,427 Tons gross, passed over the Stockton and Darlington railroad the same year." The idea that 1,500,000 tons of freight as stated by Mr. Morris will wear out, or use up the rails of any decently constructed and located railway in ten years, even a plate rail, is preposterous.

The London and Birmingham railroad, and many other railroads in England, and on the continent, would by this time require new rails, and then, consider the speed on the English railways. Of cast iron rails de Pambour says: "The lowest price I have ever heard of was $2\frac{1}{2}$ cents per pound. Fifty six dollars per ton = about the average price of best English rolled rails delivered in New York, in 1841. But, twice the weight of cast iron, would not be as safe as the ordinary rolled iron rail, so that we could well afford $120 per ton for rolled iron and have a better road, than with cast iron rails, even at $2\frac{1}{2}$ cents per pound delivered in New York. The price of $120 would command American rolled iron made with charcoal and would do not a little, to still further increase the difficulties under which the railway system labors, especially in New York. For, if in addition to the absolute prohibition from carrying freight, as at present, the price of iron rails be doubled, it will be impossible to extend a system, which is at least as much required here, as in any State of the Union, to keep pace with our neighbors.

We may be uncharitable but we fear Mr. Morris in his zeal to advance the trade of cast iron rails in Pennsylvania, has indiscretely given a side thrust at the railway cause that smacks strongly of the education of a canal engineer. We are led to this remark, as we find he quotes the views of the canal commissioners of Pennsylvania to support them, who we regret to find exhibit the same prejudices against "the better improvement of the age," as the canal commissioners of the State of New York have exhibited on several occasions. The latter, still permit the exploded heresy to be before the public, (see in one of our State reports,) that, "the average *cost* of transportation on the Baltimore and Ohio railroad, and on the Liverpool and Manchester railroad, *when reduced to a level*, is $3 and 56 cents per ton per mile. This allows no freight or tolls. It may therefore be considered, that experience has thus far (1835, Assem. Doc. No. 396) settled the cost at $3\frac{1}{2}$ cents per ton per mile on a level road," and they further state, in this famous report, "taking the facts we have obtained, as a basis, we find the relative cost of conveyance, is as four and one-third, to one, in favor of canals,—this is exclusive of tolls and profits.'"

As a practical querie and test of the sincerity of the canal advocates, in their belief of this report, we would ask, (although a digression from the subject,) why refuse the railways, parellel to the line of the Erie canal, the permission to carry freight, *at all seasons*, or on their submitting to the unjust tax of paying canal tolls, into the State Treasury? The truth is, the canal advocates both in Pennsylvania and in this State shun an investigation into the cost of transportation on well constructed railways, and their relative, merits compared with canals and are disposed to give them a side blow, when opertunity offers. They each have their seperate advantages and can work together, but these are locations with descending lines, (as from Lake Erie to the Hudson,) over which freight *if in large quantities*, can be carried by railroads as cheap, if not cheaper than by the canal.

J. E. B.

THE PARIS RAILROAD ACCIDENT.

Our readers have by this time seen most of the details of this horrid catastrophe, but as a matter of record and as a warning we transfer the best account we can find, to our pages, together with such remarks as have been made by scientific men who were upon the spot.

The accident seems to have been caused by a high velocity and the use of two locomotives, the first being a weak one, upon four wheels, when the axle broke, the second engine became a wreck upon the ruins of the first, and the newly painted cars being piled in a mass upon the fires were consumed with the most dreadful rapidity. The terrible destruction of life, however, was owing to the barbarous practice of locking the passengers in the cars. The reason given for this, was that persons were in the habit of commiting suicide by jumping from the cars, and thus this overwise precaution has been the means of destroying nearly as many, if not more lives than can be charged to all the railroad accidents on record.

We have noticed with surprise that this custom has been adopted on some of our own roads; but as the suicidical propensities of our nation can not be assigned as a reason for it, we are inclined to suspect that it arises from a desire to prevent evasion of payment—no other reason being apparent. Be this as it may we hope this warning will produce a change. Indeed, the whole history of this catastrophe is worthy of serious consideration.

"We find the following in the *Montteur Parisien;* "Scarcely had the train quitted the Bellevue station than the axletree of the first locomotive, the *Mathieu Murray*, broke. The shock drove it off the rails, and it was instantly stopped. The second locomotive, which had all its power on, rose over the first, breaking it to pieces, and crushing the conductor and strokers. In the concussion it was also broken, and the fire and grease-boxes fell upon the ground.—At the same moment, the three first wagons were dragged upon the locomotives and were broken to pieces. Most of the persons in these wagons were enabled to escape by throwing themselves out of the windows; but about forty, who were too much injured to follow the example, were burned to death by the fire, which had communicated itself to the wagons from the locomotives. The fourth wagon and those which followed did not share the same fate, but the passengers received severe wounds or contusions, and as soon as it was possible to ascertain the extent of the disaster, it was found that more than fifty persons were so severely injured that it was impossible to remove them on the instant. The prefect of police, having been apprized of the calamity, soon arrived from Paris with twenty medical men and some municipal guards on horseback. The wounded were dressed, many amputations being performed on the spot, and were then conveyed with all possible care to the neighboring chateaus, the owners of which received them with great readiness. As to the unhappy victims of the first three wagons, it was with great difficulty that the remains and ashes of forty-two persons could be extricated. They were so dreadfully burnt that from thirty-four to thirty-five were not recognizable. Seven only were females. These sad remains were conveyed in a wagon to the railway station in Paris, where they were laid in the waiting room. In the morning, seven bodies, which were in a state to be recognized, were removed to the Morgue; the others were conveyed to the cemetery of Mont Parnasse for interment, previously to which they were exposed, as also those remains of their clothing which might assist recognition. The perfect of the police did not quit the scence of the accident until 4 o'clock in the morning."

The same journal adds the following summary additional particulars communicated after the writing of the above account:—

"It is said that the second wagon, in striking against the first, dashed in the hinder part, and went partly into it, breaking the limbs of the unfortunate persons who were there, and, by blocking up the space, rendered it impossible for them to escape the fire, which broke out almost immediately after. As soon as the crash took place, a general panic seized on the passengers; the persons placed on the roofs threw themselves down from the height; those inside making wild and unavailing efforts to get out by the windows of the fast fixed doors. The horror of the disaster at this moment may be imagined. The fire had communicated to the heap of broken carriages and boilers, in the midst of which were struggling with each other the wretched victims of the accident! Some covered with blood, others scalded with the boiling water, were, when they escaped from the heap, seen running here and there, whilst others again perished in the flames, without the possibility of assistance being given them! We saw one person who happened to be in the foremost compartment of a carriage, and who, though he had received no wound, had experienced such an emotion of fright that his memory totally failed him, and he remembered nothing.

"Wednesday morning Messrs. Majendie, Amussat, and some other physicians repaired to the cemetery of Mont Parnasse, to make observations on the bodies of those who perished. On the suggestions of M. Lhopital, the keeper of the cemetery, orders had been given by the Commissary of Police of the district, to spread chlorate of lime over the dead bodies to preserve them as long as possible. M. Ganal, who happened to be there for an exhumation, remarked that chlorate of lime, which has the property of decomposing putrid gasses, attacks the flesh of dead bodies and hastens putrid fermentation. He suggested an external application for momentarily stopping the decomposition, which was immediately applied.

"The bodies now lying at the cemetery of Mont Parnasse amount to 27, some of those at first brought there having been removed. It is utterly impossible to recognize one of them, every feature being gone, and the whole body being more or less calcined. On none can a finger or toe be seen, though the stumps still remain. The teeth are generally white and uninjured, giving another proof of the indestructibility of that part of the human frame. It was by her teeth that Madame Dumont d'Urville was recognized. The color is in all cases the same—a dark brown, such as is seen on smoked hams or bacon. The abdomen is in all cases in better preservation than the other portions of the bodies. The reason is, that the strong integuments which covered it allowed the liquid matter below to become heated, or even to boil, without the external coat being destroyed. In one body the upper and lower jaws, as well as the malar bones, are completely destroyed, yet the tongue is perfectly soft and moveable in the mouth. In another, the upper part of the skull is burnt off, and the adjacent bones completely calcined; yet the brain is soft to the touch, and the thin membrane unbroken. Five or six have the hands held up before their faces as if defending themselves from the attacks of the flames. In that position they met their fate. Messrs. Ausat, Majendie, Olliffe, and other physicians, who have visited the cemetery, have declared the case to be such as may never again be witnessed. They have suggested that an application should be made to the minister of the interior to have these remains, if unclaimed, or at least part of them, in the Pathological Museum.

"The Societe de Geographie, of which Admiral Dumont d'Urville was president, directed the most minute search to be made for his remains. His body was at length found, but in a frightful state. The action of the fire upon it had been so intense that all his limbs were nearly consumed, and of one of his arms only a few inches remained. The identity was rendered possitive by the following circumstance:—Whilst the search for the body was making, M. Dumoustier, professor of phrenology, and who was attached to the last expedition of the *Astrotabe*, commanded by the illustrious navigator, conceived that he discovered, among the fragments in the cemetery of Mont Parnasse, a skull having left upon it a small portion of the scalp which struck him as corresponding with that of the Admiral, which was of peculiar conformation, and from which he (M. Dumoustier) had in life taken several casts. His opinion was confirmed on comparing this relic with the plaster casts of the Admiral's head still in the possession of the phrenologist. Precautions had been taken by the authorities to place side by side the remains of the victims found in each carriage, and guided by certain indications of a complaint to which Madame Dumont d'Urville had recently been subjected, M. Dumoustier was enabled also to identify her remains, and other scientific data also made him recognise beyond all doubt those of their son."

An English gentleman, who was in one of the cars, says:—

"A minute or so before the accident, I became alarmed at the velocity with which we were traveling, and observed to a friend who was with me, that the slightest obstruction in the road, even in a stone, would be sufficient for our destruction. My fear was, that the engineer had lost all control over the locomotive, and we would run over one of the high banks, which are numerous on the road—when every person must have been killed. When the shock took place, I endeavored to get the door of the carriage in which I was setting, open, but it was locked, by way of precaution, it seems, against persons throwing themselves out and commiting suicide, as was done by an agent de change about a year ago. As the wind was fresh the windows were up. I broke one of these; and rushed out, as the train had stoped. On looking before me, I saw five or six of the first carriages actually piled upon each other, for it appears we had a locomotive pushing from behind, as well the two in front, and the impulse had driven the carriages over each other, so that they formed a mass as high as the first floor of a house: The fire from the locomotive had reached the carriages, and they were burning furiously. The screams of the females were awful; never shall I forget the appaling sounds of agony and dread that reached my ears. The clothes of one female had caught fire, and every attempt to extricate her was in vain, for her legs were jammed in among the fractured timber of the carriage, and all who attempted to save her had the horror of seeing her burn to death.

"The accident appeared to have been caused by the enormous velocity of the train when coming to a cross rail. The first locomotive ran off, and striking against the bank one of the axletrees broke, and caused the sudden shock which had proved so fatal. This locomotive, I understand, (for I was too much agitated to examine it,) was only on four wheels, whereas most of the locomotives on this road have six. If there had been six wheels to this locomotive it would have still run on; probably the shock would have been less sudden and disasterous. Certainly if the abominable practice of putting an impelling engine behind had not been adopted on this occasion, the consequences would have been far less extensive. Two of the strokers were, I was told, killed, and McGeorge (an Englishman the superintendent, a most valuable servant to the company, who was with the train, was also reported to have been killed.'

"*A quarter to five.*—The number of bodies taken to the Morgue is now stated to be twenty, others say as many as forty. They are in such a state as to be scarcely recognizable. The number interred at the Cemetery of Mont Parnassee is said to exceed thirty. Several wounded persons, many of them so injured as to leave no hope of recovery, have been landed by the St. Cloud steamer. There is, therefore, every reason to believe that the number of killed and wounded really exceeds one hundred. If the persons who were in the first three carriages were nearly all killed, as my informant from Mendon reports, the number of killed alone must have exceeded eighty. I still hope, however, that the number may be smaller; but that forty or fifty have been killed, and double that number more or less grievously wounded, seems to be the general belief. At the hospital Neckar, more than thirty wounded have been received during the day.

"During the sitting of the Academy of Sciences M. Cordier communicated various details of the accident, extracted from an official report addressed to the Minister of the Interior by Messrs. Combes and De Senarmount, the engineers of mines, charged with the inspection of railroads. In addition to the facts already known, it states that the foremost locomotive was a small one with four wheels made by Sharp and Roberts. The boilers of both are at present without the slightest injury. According to the testimony of the Commissary of Police at Meudon one of the carriages was altogether consumed in ten minutes. The report attributes the accident to the use of the small locomotive, and recommends that such machines should not for the future be employed. The Academy listened to the account in mournful silence. Several members afterwards made remarks on the inconvenience of using locomotives with four wheels. Mr. Elie de Beaumont particularly protested against immense trains being drawn by several locomotives, the danger increasing in proportion to the number of machines employed. The custom of locking up the passengers was also much spoken against."

"Every thing has been done in the way of inquiry and remedy that the lapse of time has allowed. The official proceedings and regulations and the scientific studies and conclusions will be instructive and practically beneficial for all countries. The adminstrators of the railways of the right bank of the Seine publish this day a series of new and very minute precautions which they have adopted in consequence of the public dismay. They announce that their two roads of St. Germaine and Versailles have carried, since their opening nine million of passengers, without fatal or serious accident, and the Bergian railways, from the 5th of May, 1835 to December, 1841, nearly twelve millions, with the loss of only three lives; and that the French and Belgian cars have run altogether in that transportation nearly a million of post leagues. As a set-off to the St. Phillip catastrophe, the loss of life and the maimings by vehicles in the streets of Paris is computed and arrayed. It is a fearful record which will not be diminished by the extension of wood pavements."

Several years since we gave an account of the marvelous process by which Signor Sigate had succeeded in mineralizing flesh in such a manner as to retain the color and form unimpared. Since that time we have conversed with a gentleman who examined the collection which he pronounced most curious and wonderful. The following extract from Dr. Mott's travels contains a somewhat detailed description of this singular collection.

CHEMICAL PROCESS OF PETRIFYING HUMAN FLESH.

"The most novel and piquant treat of all others to me in the beautiful capital of Florence was my several visits to signor Sigate, a scientific gentleman possessed of a wonderful art unique and unknown to all the world besides. Incredible, if not marvellous, as it may seem, he has discovered a chemical process by which he could actually petrify, in a very short time, every animal substance, preserving permanently, and with minute accuracy, its form and internal texture and in such a state of stony hardness that it could be sawed into slabs and elegantly polished.

"He had in this way formed a museum of various animals, such as frogs, fishes, toads, snakes, and a great variety of parts of the human body in a natural and diseased state. In my presence he threw the human liver, lungs, heart, and other parts thus petrified, about the flour with perfect impunity, and without the least injury being done to them. Still more curious, he had with Italian taste, cut them into small pollish squares, and arranged them in complete table of mosaic work ! so that it gave him as much delight as it did me astonishment to find that I could with my finger designate to him, on this precious centre-table for a surgeon's drawing-room, the appropriate name and character of each individual object that spread out before me in a pathological chart of real specimens.

"Thus a pulminary tubercle or ulcer here, a hydatid of the liver there, a cicatrix in the brain in another compartment, and a calculus in the kidney, or ossification of the heart's auricles and valves in a fourth. It struck me that, for all anatomical and surgical purposes and all objects of natural history, this was an art of inappreciable value, and the most desirable ever discovered ; and with that view I conversed with him relative to a visit to our country, believing it would be of national importance if we could have the benefit of his services.

"I even entered into some preliminaries of a negociation with the design of obtaining him for my own purposes, but I found him sadly involved in debt, and that his demands were too exhorbitant to be complied with. I, however, made liberal offers, and did not entirely despair that he would have acceded to them, when, to my regret, about three weeks after we left Florence, I was informed by a letter, that he was suddenly attacked with a violent inflamation of the lungs which proved fatal, and what is as much to be deplored, that his unprecedented discovery died with him. He never would divulge the least part of his marvelous process, but when pressed by me on the subject, hinted that he had acquired it in his various journeys in remote Eastern countries; and it is fondly to be hoped some one may ere long appear who, in persuing this inquiry, will be enabled to recover the art among those people from whom he intimated he had obtained it. It is worthy of observation, how, in this extraordinary process, art accomplishes in so short a time, what nature requires so long a period to effect, and then never with any thing comparable to the perfection, we may say almost identity, with which this mode preserves an exact fact simílar of the original; in truth the original itself. In this surprising and almost magic art not only, as we have said, the exact exterior outline is faithfully and exactly represented, but also the most minute and delicate interior arrangement of structure admirably perpetuated; as for example, the entire viscera of the chest and abdomen, with all their varied and beautiful convolutions, were clearly exhibited, retaining even the colors of the blood-vessels in preparations of frogs, birds, and other animals, besides the human body."

Dr. Mott's Travels.

The following article from the Boston American Traveller gives some idea of the manner in which railroads are destined to contribute to the luxuries as well as the comforts and necessities of life, We are glad to find that the directors of the Western railroad understand the art of converting the whole country into a garden for our great cities.

A little ingenuity expended in this manner may contribute greatly to the usefulness of railroads.

FREAKS OF RAILROAD TRANSPORTATION.

"Three thousand *wild pigeons*, from *Michigan*, arrived in this city, on the 25th nst. alive, over the *Western Railroad.*

"1,500 bushels of *wheat* were, last week, *bought in New York city*, carried up the North river to Greenbush and thence sent to Sutton, near Worcester, *over the Western railroad.*

"We understand that the Western Railroad are about preparing *refrigerator cars*, in which *fresh beef, pork, veal, poultry, pigeons*, venison, wild game, and *other fresh meat* can by a moderate quantity of ice, be kept in *perfect order in the heat of summer*; and in which (in winter) they can be *kept from freezing;* thereby, in either case, *adding much to the value of the article*, when carried to market.

"These *refrigerator cars* will be used, for the like advantageous purpose, to carry eggs, butter, lard, *fresh fish, oysters, lobsters, vegetables* cheese, lemons, oranges, strawberries and *all berries and fruits and roots:*—being a mode of transportation of great value, for nice delicacies, which bear a good price.

"We also learn that it is contemplated that these refrigerator cars shall go with the passenger trains, *in twelve hours, through* from Albany to Boston; and shall be placed between the tender and the passengers cars, giving additional security to the passengers, in case of accident.

"If our Michigan and Ohio friends will put, in refrigerator cars, the fresh meat and the wild game they intend for this market, they can send their cars to Buffalo on the lakes; and from Buffalo to Greenbush, partly by railroad and partly by canal, or wholly by the Erie canal. Then from Greenbush, it can come to Boston quickly and in perfect order, the moment the system now proposed is perfected. In like way, a chowder of fresh Massachusetts codfish will readily be obtained at Chicago.

"It may be asked "what is a refrigerator car?"—It is simply a common car, with a hole at bottom, which you stop by a spunge, that spunge allowing the water to drop down, while it impedes the air coming up into the car. Then you have four inches of powdered charcoal on the sides and top and bottom of the car compactly, between the two boards, which form each of the sides, as well as the top and bottom.

"If it be said that it is difficult to make so large a refrigerator, as an 8 wheel car will be, we need not only reply, that the ice-houses at Fresh-pond, are, in fact, large refrigerators, and that some of them are large enough to contain 8,000 tons of ice, and have kept ice from melting for a whole year and longer too.

"In sending a cargo of ice to Calcutta, we so arrange the hold of the ship, as to make it virtually, a large refrigerator; and we do this so efficiently, that, crossing the equator twice on her passage, and being for a long time in the warm water and under the burning sun between the Tropics, she yet wastes scarcely any of her cargo. *Barrels of apples kept cool, in this refrigerator, arrive in Calcutta from Boston, in the most perfect order, and command a great price.*"

The Earl of Rosse hitherto known as Lord Oxmanton, has commenced the construction of an enormous telescope far beyond any thing ever yet attempted This nobleman possesses what are not often united great scientific knowledge and much money. We understand that from the great size and brittleness of the speculum, it will require two months to complete the annealing process in an oven built expressly for the purpose. After all the experiment is rather one for ascertaining the extent to which human ingenuity can carry the size of the telescope than for any specific application, as the limit of usefulness determined by Herschel was below forty feet focal distance.

"*The Earl of Rosse's Telescope.*—The following account of the speculum metal of this Leviathan Telescope, we extract from a letter from Sir James South, a distinguished Astronomer, to the Editor of the London Times. The Telescope receives its name from the Earl of Rosse, near whose castle and under whose directions the works are conducted.

"The metal is 6 feet diameter, it is 5 1-2 inches thick at the edges, and 5 inches at the centre; its weight is about 3 tons.

"By grinding and polishing, its thickness will probably be reduced to 1–10th of 1–8th of an inch—it will be formed into a telescope of 60 feet focal length, and will, there is every reason to hope, be actually in use this year.

"The speculum will have a reflecting surface of 4071 square inches, whilst that of the telescope made by the immortal Herschel, under the auspices of King George III. had but 1811.

Observatory, Kensington. J. South.

"By the following from the Lancaster Intelligence and Journal, we are pleased to see that Mr. Herron, has had an opportunity of making trial of his improved Railway, and that the trial has resulted so favorable to its reputation."

IMPROVED RAILWAYS.

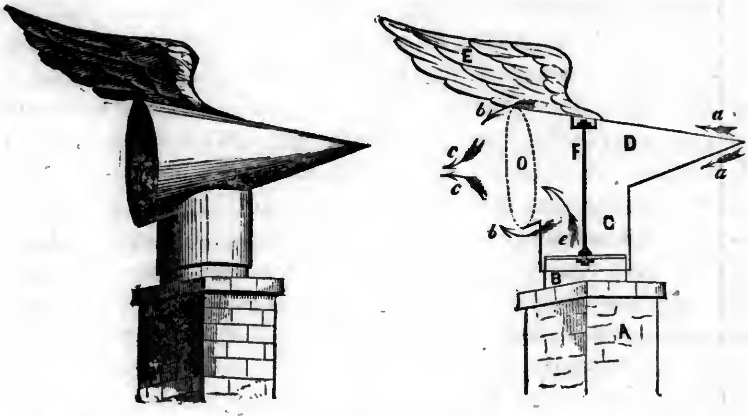
"The subject of improving the construction of railways in our country has not, hitherto met with that attention, particularly from those who are interested that it deserves. There are certainly very plain reasons why this is so. For though study may do much, and men of scientific attainments and inquiring minds, have devoted their time and attention to it, yet the defects in all our public tracts are evident to all, and ruinous in their consequences. But all the speculative opinions upon this subject, that have been put forth, and the numerous experiments that have been made, leave ample space for range of thought and renewed efforts. In all that we have read, and in all that we have seen, however promising—after suffering numerous disappointments, we now place our reliance upon a simple inquiry—"Has it been tested?" We heard and we must acknowledge we were rather sceptic, of a plan different from all others, that has been adopted by the Baltimore and Susquehanna Railway company, in the construction of a section of their road, commencing at the depot. This section was laid according to a plan patented by Mr. Herron, civil engineer, and has been in opperation for upwards of two years. The matter had entirely escaped the memory of the writer, but was brought vividly and in a very interesting manner to his attention, by the following paragraph, which appeared in the Baltimore Patriot of the 23d inst:—

"*The improved Railway track.*—Two years ago a portion of Railway was constructed near the depot of the Baltimore and Susquehanna rail-road in this city, according to the patent trellis system devised by James Herron, civil engineer; and is now (having withstood thé breaking up of two winters' frost) in *as perfect order as it was the day it was laid down*, although it has not received the slightest repair. It costs *less* than the old defective system of construction. These facts ought to arrest the attention of all concerned in railroads, and may be verified by reference to Charles Howard, Esq. the enlightened President of the company, who was the first to afford an opportunity of testing the new improvement.

"This short notice was sufficient to excite a desire to become more intimately acquainted with a plan which has given such unqualified satisfaction, after a lapse of time sufficient to detect defects if any existed, and thus I had an opportunity afforded by the reception yesterday, of a neatly printed quarto, entitle a practical decription of Herron's patent trellis railway structure," etc. illustrated by engraved plans, with ample explanations, cost of materials, etc.

"It is my intention, as soon as time will permit, to give a short review of the work, in which I shall endeavor to set forth some of the peculiar claims which Mr. Herron's plans have to the particular consideration of all who are concerned in the construction of railways.

ESPY'S PATENT CONICAL VENTILATOR.



We are happy to learn that this important invention has at last attracted the attention of our government, and is gaining popular favor throughout the community. The inventor, James P. Espy, Esq. well known in this country and in Europe, as the discoverer of the "law of storms," it appears is reaping a richly-deserved harvest for his genius and pesevering enterprise. His apparatus has already been employed for ventilating several of our ships of war, as well as the public buildings at Washington, and answers every desired expectation. It is well adapted to the purpose of ventilating public buildings, ships, kitchens, cellars, cisterns, vats, mines, stables, etc. Also for produc'ng a strong draft in chimneys (and thereby prevent their smoking,) flues to steamboats, locomotives, and a multiplicity of other purposes. It may be described as follows; reference being had to the letters in the above diagram, which represents a vertical section, and a full view of the ventilator attached to a chimney:—

A, denotes a chimney.
B, a sheet-iron pipe, secured upon the top of the chimney:
C, a sheet-iron collar, fitting loosely over the pipe B.
D, a hollow cone, made also of sheet iron into which the collar C, enters.
E, a vane, to keep the cone pointed to the wind.
F, a spindle, on which the apparatus revolves.

The arrows *aa*, *bb*, *cc*, and *e*, indicate the direction of the currents fo air. Suppose the wind to blow in the directon of the arrows *aa*, it will pass along the surface of the cone, from its apex to its base, where it will converge as represented by the arrows *bb* and *cc*, and produce a partial vacuum at O, the mouth of the cone, and consequently a strong current of air will rush up the chimney A, in the direction of the arrow *e*.—*Hunt's Merchant's Mag.*

[From the Civil Engineer and Architect's Journal.]

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

Second Course—Lecture 1.—*Railways.*—Mr. Vignoles commenced by saying, that, in pursuance of the order stated in his introductory lecture, he would proceed to investigate the principles upon which railways should be laid out under varying circumstances. In calculating the power (of whatever description it may be) necessary to overcome the resistance of a load to be moved on any railway or road, it may be divided into two parts—viz. that necessary to overcome gravity, and that required to meet friction. The former is, of course, common to, and equal on, all descriptions of roads deviating from the horizontal line, and is in proportion to the sine of the angle of inclination; the latter is regulated by the degree of perfection of the road, and of the vehicles moved upon it, and includes the resistance of all obstacles to the rolling surface, or periphery of the wheel, in addition to the axle friction due to the load or weight placed upon the carriage. It has been assumed, from experiments and observations, that the average friction upon a railway is 9 lbs. per ton, and that this continues the same at all velocities; but there is reason to believe that the latter part of the assumption must be much qualified. The gravity due to the inclination of the plane being added to, or subtracted from the friction, as the plane rises or falls, the sum, or difference, will give the total amount of power necessary to overcome the resistance of the load. The power necessary to overcome the gravity being expressed by the proportion which the rise of the plane bears to the weight to be raised, (say, for example, a ton,) is found by dividing 2240, the number of pounds in a ton, by the denominator of the fraction which expresses the inclination of the plane; thus, on a plane rising one foot vertically in a horizontal distance of 1000 feet, the fractional expression is $\frac{1}{1000}$ and the power (retarding or aiding the load,) will be the thousandth part of a ton, or $2\frac{1}{4}$ lb. It is evident that, as we arrive at steeper inclinations, this power will at length become equal to that required to overcome the friction; thus, on an inclination of $\frac{1}{250}$ it will be $\frac{2240}{250}=9$ lb. per ton, and this being subtracted from the friction, on a railway which is commonly taken at that same amount of 9 lb. per ton, it results that no power is required to move a load down such an inclination, or wherever the gravity and friction are equal, and balance each other. The angle that such an inclination makes is called the angle of repose, but will, of course, vary with the friction due to various descriptions of roads and vehicles. On steeper inclines than such, not only is no power wanted, but there is a gravitating power due to the descent of the plane, and so strongly does this act in steep inclinations, that it is necessary to put on the break, to retard the velocity which it occasions. It is found, however, when a train is allowed to descend a steep plane without retardation, that, owing to the resistance of the air, it will, after acquiring a certain velocity, cease to be further accelerated; many theoretical writers have fallen in-

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to error, by supposing it dangerous to allow trains to descend inclinations steeper than the angle of repose without applying the break. On railways where there are inclined planes of $\frac{1}{100}$ for several miles together, the trains often commence the descent at the rate of upwards of forty miles an hour, and the speed, instead of being accelerated, has been quickly reduced to little more than the thirty miles an hour, or to such uniform velocity that a railway train will acquire on that inclination, varying a little with the weight of carriages, or the length of the train; such being the case, it is evident that lines of railway for locomotive power, can be safely laid out with inclinations of 1 in 100, and even steeper.

It is of the utmost importance, in laying out a line, to consider the power which is proposed to be employed, and the mode of obtaining it; thus, if it be intended to lay out a horseway to carry coal from a collery to a shipping place, the line should be made always to descend, and so regulated, that the number of full wagons that may be sent down be that number which may be taken back empty. But horse-power being extremely limited, recourse is had to steam, and the locomotive steam-engine has been applied to railway travelling, as being better suited to the purpose than animal power. The power of the locomotive engine may be defined, not so much by horse power, or cylinder power, as by boiler power, or capability or rapidly supplying steam to the cylinders, and still more by adhesive power, or the weight insistent on the driving wheels, so as to have purchase, as it were, to drag the load after it, for the wheels will slide, more or less, and, under some circumstances, will merely turn round on the rails, without progressing.—Many lines appear to have been laid out under the impression that the locomotive engines would always have to carry a *maximum* load, and, in accordance with this principle, and to enable them to do so, it was some short time since laid down as an axiom, that no inclination should exceed $\frac{1}{330}$ and that gradients should be constantly uniform through the whole length of the line. Experience has shown, however, that the practical cost of conveyance of ordinary trains over lines greatly varying in their gradients, does not materially differ, the wear, and tear, and fuel, seldom being increased so much as 10 per cent., and the other expenses and contingencies being the same, whatever the gradient of the railway, the difference on the whole expense of working and maintenance becomes very small indeed. In laying out a line, then, the traffic must be considered quite as much in the distribution of it as in the totality; for it is evident that, to accommodate the public, the trains ought to go often, and will, therefore, generally be light; and when we consider the great economy in construction, and the little additional expense incurred in the afterworking, we may conclude that railways may be advantageously laid out with much steeper inclinations than they have in general hitherto been, particularly in the remote districts, where the railway system has not yet been extended. A powerful engine will draw an immense load on a level, whereas it often has not more than twenty tons to draw—consequently, gravity ceases to become an object; and even should the traffic increase in course of time, it will be better to send frequent and light trains than, in the original construction, to incur heavy cost to graduate the road for heavy trains, which are seldom to be carried. This principle must, of course, be confined within certain limits; thus, lines may be laid out with better gradients, where the traffic is very great, and will justify the expense and inconvenience which might result from an engine having always to go up a steep ascent. Railways in England have cost, on the average, £30,000 per mile, and the first cost of locomotive power does not amount to one-fifteenth of that sum. The interest on the capital is, therefore, very great, while that on the power is small, as is also, comparatively speaking, the daily cost of transit due to the power only. If these proportions were different, the latter being increased, while the larger amount (the interest on the cost of the works) were diminished, the capital sunk in railways might have been reduced fully one-half, with equal satisfaction and benefit to the public, for whose use they were designed, and with greater profit to the shareholders.

Lecture II. Railways—Locomotive Power.—In the last lecture it had been stated that the adhesive power of the locomotive engine depended upon the weight borne upon the driving wheels.—The greatest amount of adhesion of iron upon iron, according to the experiments of the eminent engineer, Mr. George Rennie, as published in the Philosophical Transactions, appears to be about one-sixth or one-seventh of the weight of the insistent load. In the locomotive engine, where the bearing of the wheels is upon smooth surfaces, the adhesion will, of course, be less; and in weather when rime or mist congeals upon the rails, it is very small indeed, sometimes none at all. But in ordinary states of the rails, and of the atmosphere, one-fifteenth may be taken as an average. The vicissitudes to which this power is subject, will often account for the varying rates of railway travelling, and it is only when the resistance of the load is less than the smallest amount of adhesive power which the state of the weather or the rails will admit, that the time of transit of a train over any given distance can be insured. Now, the usual weight bearing upon the driving-wheels of an ordinary locomotive, for passenger traffic, is about seven tons, or 15,680 lb.; one-fifteenth of this will be 1042 lb., or, in round numbers, say 1000 lb., for the average available adhesive power of such an engine for moving a load, and on the amount of this alone will depend the weight which the locomotive engines can draw after it. The other principal element which must be taken into account in the locomotive engine—viz. the speed—will depend mainly upon the power of the boiler to generate steam with sufficient rapidity. A boiler may have quite sufficient power to move (at a velocity of three miles an hour) a load of which 1000 lb. shall be the representative, but it must be of a far superior description, and far higher powers, to move the same load at a velocity of thirty miles an hour; and this subject does not appear to have been sufficiently considered, though it is of such paramount importance thoroughly to understand the nature of the moving power to be used, before going into the subject of the gradients, or the principles of laying out the line. The amount of the load, then, which the engine can draw, will depend chiefly on the adhesion, and the velocity will depend on the boiler where the stream is generated, the cylinders being proportioned to each of these two other regulating powers. And not only must the steam be generated to a given pressure to produce that power, but with sufficient rapidity to continue it; and keeping up a high velocity, it must be, as it were, rammed into the cylinders, so as to produce the greatest possible effect in the least possible time, and this is the reason why high velocities are so very expensive, as the same effect might be produced by one-fourth the quantity of steam, if sufficient time were given to expand it. But there is yet another circumstance that modifies the amount of adhesion—viz. the inclination of the road. It is manifest that, if the road were vertical, the engine could have no adhesion upon the rails; and, therefore, between the perpendicular and horizontal lines, the power must undergo many degrees of variation, quite independent of the atmospheric cause already mentioned. We have no experiments to determine the ratio of that variation, but reasoning from analogy, it may be assumed to be the sine of the angle of inclination, or in the same proportion as the resistance arising from gravity, so that practically the diminished amount of adhesion, on any inclined plane, might be found by deducting the resistance of gravity on that plane from the constant of 1000 given above; thus, on an inclination of 1 in 100, the gravity of the engine per ton (or 2240 lb.) will be $\frac{2240}{100}=22{\cdot}4$ lb., and that for seven tons will be $22{\cdot}4\times7=157$ lb., which, subtracted from 1000, will give 843 lb.= the diminished amount of adhesion, which will be the limit of the power of the engine on that incline, as regards the load, no matter how great the boiler or cylinder power may be. And to find the load which this power will draw, we must take the sum of the resistances arising from gravity and friction for one ton, and the adhesive power divided by this sum will be the amount sought in tons; on an inclined plane of 1 in 100, the calculation will be found thus:—Friction 9 lb. per ton, *plus* gravity as before, $22{\cdot}4=31{\cdot}4$ lb., and adhesive power 84·3, divided by $31{\cdot}4=26{\cdot}7$ tons, which is only one fourth of what might be drawn on a horizontal line. Hence the advantage of heavier engines, which are daily coming into use, as also the property of coupling the wheels of engines for drawing heavier loads up steep inclines, and by this means the whole insistent weight of the engine is rendered effective by adhesion, and the load the engine can draw after it proportionally increased. In calculating the amount of resistance of a load upon a railway, the friction had been assumed to be 9 lb. per ton, rather in deference to general opinion than otherwise; it was probably much higher. It is considered that the friction of the engine and engine gear is 16 lb. to the ton, but that of the lighter carriages less; however, if this number (9 lb.) should be proved incorrect by future experiments, the principle of the calculation will not be altered, and it will only be necessary to substitute for 1000 whatever number shall be found on closer investigation to be nearer the truth.

The power generated in the boiler, and applied in the cylinders, now remains to be brought under consideration. This may be stated to be the capability of the boiler to supply steam of high pressure, to enable the piston to perform a given number of strokes per minute, which accordingly will be one of the essential elements in computing the power of the engine; and therefore it is that we are always unwilling to define it by any number of horses' power, since it is clear that the engine which, moving at the rate of 15 miles an hour, would be called a 20 horse engine, would be styled a 40 horse engine when moving at the rate of 30 miles an hour, all other circumstances remaining the same. But it does not follow that, because the number of strokes per minute be increased, that the power available for locomotion be increased also, and in this consists the essential difference between locomotive and stationary engines, for in the former there are circumstances, as before shown, which circumscribe that power, over which the boiler has no control; and, as regards the locomotive engine, a third point must be taken into consideration. It is a well known theory, that, if a metallic substance be in contact on one side with water, and that heat be applied to the other, that once the body becomes thoroughly warmed, the caloric will be taken up by the water with as much rapidity as it can be supplied to the metal. Now, in the locomotive engine, there is an immense area of heating surface in contact with the water in the boiler, in consequence of the numerous tubes which pass through it from the fire-box to the chimney, and it is on this principle that what is called the steam draft has been introduced, by which means the caloric is rapidly drawn from the fire through these tubes, and as rapidly absorbed by the water with which they are in contact, for the production of steam. It is evident that, in proportion to the rapidity with which the piston moves, and with which the waste steam is injected into the chimney, will the heat be absorbed by the water from the tubes and steam generated, the effect of which is, that the faster the engine goes, the quicker it generates the steam; and this forms another great beauty and peculiarity in the locomotive engine. The principles of calculating the moving power being thus explained, the way has been sufficiently cleared for entering on the subject of the laying out of railways.

Lecture III.—After recapitulating a few of the leading points which were stated in the last lecture, the professor called particular attention to the formula whereon he had based the calculation into which he had then entered, and he now exhibited tables and diagrams in further illustration. The adhesive power of 1000 lbs. was assumed as the average of what a locomotive engine will have in all states of the weather, and of the rails; but if the wheels be coupled, or the insistent weight otherwise increased or diminished, the adhesive power (on which depends the load) will be altered in the same proportion, subject also to variation from the state of the weather and the road, and undergoing the stated diminutions from the effects of gravity on all planes which depart from a horizontal line, the velocity of the train depending on the evaporating power of the boiler. But in the stationary system the engine winds (upon a roller, or over a sheave or wheel) a rope supported by pullies, placed at regular distances along the road, and to which rope the train is attached. Mr. Vignoles stated that the student may refer with confidence for every information on this subject, to Mr. Wood's *Treatise on Railways*, and commented on the extracts he made from that work.

Atmospheric Railway.—There is also another mode of applying the stationary engine to the purposes of locomotion, by producing through an air pump a partial vacuum in a pipe, thus making atmospheric pressure the moving power; and it may be interesting to state, that the scientific men who were appointed by the railway department of the Board of Trade to inquire into the system of the Atmospheric railway, had fully recognized that principle, and concurred in considering that the experiment contemplated upon the Dublin and Kingston railway extension, and recommended by the directors to the proprietors, as applicable for illustrating the principle on a large scale. On the atmospheric railway the diameter of the pipe or tube regulates the load, but the velocity depends almost entirely upon the diameter of the air pump that exhausts the pipe, the rule being that the area of the air pump must be made as many times greater than the area of the pipe, as the velocity of the train is to exceed that of the piston of the air pump. Thus, if the piston of the air pump be supposed to move at a rate of three miles an hour, and it be required to move a train at a velocity of thirty miles an hour, the area of the air pump must be made ten times the area of the pipe; the diameter will, of course, be deducted from that area. Now, it appears that the most economical pressure in the pipe (which is what engineers must chiefly look to,) is about 7 lb. to the square inch, or rather less than half a vacuum; therefore, this may be taken as the constant of the atmospheric pressure; and if we multiply this constant by the area of the travelling piston in inches, we shall obtain the effective pressure upon that piston, which, as it regulates the load, may be said to correspond to the adhesive power in the locomotive engine, but which, unlike that power in the locomotive, will be undiminished on inclined planes. Again, if we divide this power by the friction (which was before taken at 9 lbs. to the ton,) we shall obtain the number of tons which the piston, acted on by the atmospheric pressure, is capable of propelling. Thus, supposing we have a pipe of 14 inches diameter, if we multiply the area of this pipe by 7 lb., we shall find the effective pressure equal to 1078 lb., which divided by the friction, 9 lb. will give about 120 tons—the weight which can be propelled by means of a pipe of that diameter; and if the piston of the air pump move at the rate of three miles an hour, and its area equal to seven times that of the pipe, the load will be moved with a velocity of twenty-one miles an hour, and it may be demonstrated that, on ascending and descending planes, the speed, although increased or diminished at first, will soon become uniform. Of course, upon the diameter of the air pump will depend the power of the engine which is to work it. The calculations in this case will be similar to those for an engine required to work ropes—in the one case it being required to find what is wanted to overcome the resistance and friction from ropes, pullies, etc., and in the latter to find the power to work the air pump, and exhaust the air from the tube at any required velocity.

Inclined Planes.—The Professor then recurred to the effect of trains descending inclined planes. Mr. Navier (in his work, translated by Mr. M'Neill, which he mentioned as a text book on the comparison of different lines of railway,) differed somewhat from the propositions he had laid down; it was therein stated, and Professor Barlow concurred in the statement, that an engine and train did not gain any advantage in descending planes steeper than a certain inclination which they have put as the angle of repose.—Now, in practice, Mr. Vignoles did not find it so, but, on the contrary, daily experience proved that, as far as inclinations of sixty feet in a mile, the trains may, under almost all circumstances, have the full benefit of gravity in the descent. Proffessor Barlow has laid down, in several important works, which from their high standing, will have a material influence upon the public mind, that though additional power be required to surmount steep inclinations, yet, so far from gaining a corresponding advantage in the descent, there will result rather an injurious effect from the necessity of applying the break. Now, it has been already mentioned, and experiments have been repeatedly made by Mr. Wood, Dr. Lardner, and others, showing that, when engines descend long inclined planes, such as those on the Croydon railway, the application of the break is seldom necessary, the speed that would be due to the accelerating force of gravity, being reduced by the resistance of the atmosphere, until it setttes down to a uniform and safe velocity. It is evident, therefore, that there is a great deal yet to learn on this subject, when we find authority and practice differing so materially. Mr. Vignoles observed, in conclusion, that, as the laying out of the lines of railway ought to be strictly regulated by the power to be used for locomotion, as well as of the load of each train, and the nature of the traffic, it becomes interesting to consider these principles in respect of the extension of the railway system in this and in other countries; for, looking at the enormous outlay hitherto incurred, lines through remote districts would not be undertaken, unless the first cost of railways, and the annual expense of working and maintaining them, were reduced to a *minimum.*

RAILROADS FOR THE TRANSPORTATION OF CATTLE AND MARKETING.

In a previous communication, we give an extract from the Franklin institute relative to Emperor Leopold's raiload from Vienna to Brunn, to show the important fact of a railway being projected and constructed mainly for the supply of Vienna, the capital of Austria, with beeves from a particular district.

We find also the most distinguished and careful capitalist of Europe the Baron Rothschild, soliciting the privilege of constructing this road, and subscribing with his associates $7,000,000 to effect the object. It leades us to the conclusion, that if our capitalists will investigate the subject, they will seek investments in "*railways judiciously located between desirable points*," in preference to bank or other stocks, and to quote from the London bankers' circulators, consider it a permanent investment, equal to productive real estate—"*a valuable property*, which may now be set, down as being *permanently established*."

To our citizens who have witnessed the daily large arrivals of calves and lambs, from the towboats, to be placed in pens on our wharves without food and withont even water, for from not less than 24 to 72 hours, from the time they are first taken from their mothers milk, then to be piled in carts for the slaughter house.—the sight is cruel and revolting. This is not all: the feverish state in which these animals are killed, makes their flesh tough and stringy, with a disposition to early putridity, and with the poor, who are obliged to buy cheap meat, this is often the cause of disease, and thus indirectly, is a tax on the rich.

The epicure and good housekeeper will look for, and pay an extra price for "Long Island Veal," to be sure of its freedom from the taint alluded to. Again if from any cause, and it often occurs, an extra supply of fat cattle is thrown into our market, the barren pastures around Yorkville receive them, literally to starve, until the butcher's knife relieves them from their sufferings.

From the present period of the year, and for several months, it is uderstood that we receive from the rich pastures of Putnam and Dutchess, about 300 head per week of young early grass fed beef. It would be ample remuneration to a railway, to transfer these cattle daily as wanted at $2½ per head, and calves and lambs at 10 to 25 cents each, for a distance of 75 to 100 miles. The farmers on the line, in districts, would soon club, and own their *market cars*, in which they could bring to this city, their poultry, milk, butter, chesee vegetables, etc. Each car would via market, run out to its proper *sidding* or *turn out* in the Bowery, or in our avenues, under city regulations.

Refrigerator cars, a late invention on the western railway, would present to us luxuries in "fresh printed butter," that would settle this long contested question of rivalry with the city of Brotherly Love, cream and delicate fruits, that we have no idea of at present.

We are still in our infancy applying the railway system to the *regular supply* of large cities, with their daily wants, and let us add, in relieving them from their street manure, at a handsome profit, to renovate the lands from which we receive our supplies.

Imagine for a moment the introduction of a wide 8 wheel car, 30 feet long, with its cooking stove, sleeping rooms and 24 berths as commodious as the farmer now enjoys in the Poughkeepsie tow boats. To this *moving hotel*—to be in numbers proportioned to the market districts—let there be added the *market cars*, with their three decks, each deck arranged for its particular use. Poultry, with its several divisions, oxen, sheep, lambs, calves, milk, etc., in the same way, to accomodate this new channel of trafic with our city. Let our councils establish a part of the Bowery (none better than that abandoned by the Harlem Company,) canal street, or on the 3d, 4th and 6th avenues, into which the several trains can be run, on their arrival at 5 in the morning in summer, and daylight in winter to occupy their stations until 10 o'clock, A. M., when the whole would take the return train, and thus the farmer will be with his family in the evening, ready to return the next morning, after having traversed a distance of 100 to 150 miles with every comfort that can be desired.

It is true that these arrangements might not be popular with a certain class for a short period, but it would soon be found to work well. The thrifty citizen would buy his marketing cheap. The less active would take his supply second hand, not third, at our groceries.

This class of traders would clear out the farmer of his supplies before 9 o'clock. This is not all, the industrious huxter and market woman would penetrate into the country, and there make their purchases on advantageous terms, and thus cheapen the market.

We may continue this hasty sketch, to show the profit and *incidental advantages of railways to a growing city.* We cannot close our remarks without adverting to the practical effects of only completing 46 miles of the Erie railroad, to Goshen, and to the lines of railways coming into Jersey City, to give testimony in their favor, to all those who will attend the arrival of the steamboats at their depots.

In Boston, it is well known that by the construction of railways into the country, the price of milk was reduced 50 per cent. This is certainly a great blessing to the poor, and which they well know how to apperciate, in raising a family of children.

Within four to six hours distance from this city—say 60 to 100 miles—milk can be taken from the cow, reach this city in better condition by the railways, than we now receive it by carts, eight to ten miles. We know, from accurate data, that milk is not now worth one cent per quart to the farmer of Dutchess county to make butter.

It is not generally known that the demand in this city for milk (with a scanty supply) exceeds 30,000,000 of quarts per annum at even the present high prices. The saving of only one cent per quart on this amount would yeild $30,000 per annum, a sum sufficient to yield an income of 10 per cent on the cost of a railroad to Albany and Troy.

The last week market wagons were in abundance in Burlington, N. J., offering their peas to the New York accents at from 2 to 2 1-6 per basket—to be sold here at 6 to 7. But for the railway to Camden and Cloucester county, our markets would have but a very irregular and inadequate supply of early fruit and vegatables. It is well known that the poulterer, in the fall and winter, extends his trips even to Harrisburgh, in Pennsylvania. So soon as we can connect with the Western Railroad in Columbia county, we shall then have upwards of 1,000 miles of railway tributary to this city.—*N. Y. Standard.*

THE PROGRESS OF THE WEST.

St. Louis and its Trade.—We recently alluded to the wonderful progress of St. Louis. We have since been furnished by the St. Louis Chamber of Commerce with much valuable statistical information in relation to the growth of that city and the western country generally. In 1830, the population of St. Louis was 5,852. It is now rising 30,000, During the year 1841, 30,000,000 of bricks were made in the city, 25,000,000 of which were sold and used in that place. There are 9 steam saw-mills there, 3 mills for planeing boards, 2 white lead factories, 3 oil mills and 6 flour mills. The first Insurance office was established in 1831. There are now 7 officers, the total marine risks of which amount to upwards of $58,000,000. In 1841, the receipts of lead from the Galena mines, amounted to 425,000 pigs valued at more than $1,000,000. The growing crops of tobacco, will, it is said, range at from 12,000 to 15,000 hogsheads. The importation to St. Louis, of cloths, blankets, etc., intended for the American fur trade, is set down at $225,000 per annum, and the exports and home consumption of buffalo robes, peltries, etc., at $500,000. The American Fur Company employs several steam and other boats, and several thousand men. Their boats, at least once a year, ascend the Missouri to the mouth of the Yellow stone. Hemp is another staple of Missouri. It is estimated that the crop for 1842, will in Illinois and Missouri, amount to not less than 10,000 tons. This hemp is worth $200,000 in a raw state. But the most valuable exports from St. Louis and the country connected with it, are bacon, pork and lard. During the present winter, 47,000 hogs were slaughtered at Alton and 10,000 at Peoria; while it is said that the Illinois river, with the Alton trade send out annually, not less than 8,000 tons of pork. The value of this item alone, is given at $1,500,000. Flour and wheat are also important items, and show an annual aggregate of nearly $1,000,000. About 1,500 horses, 2,300 mules, and 6,000 head of cattle, were shipped during 1841 to the south. The imports are estimated in 1841, at $20,000,000.

These are but a few of the facts grouped together by the Board of trade, but they are calculated to convey a forcible impression as to the onward progress of the west. It is estimated that in 1841, $15,000,000 in exchange were sold in St. Louis. Last year, the number of steamers on the Mississippi and its tributaries was 437, about 150 of which were employed in the St. Louis trade, during the whole or a great portion of the year. As more fully illustrating the character of the trade at this point, we subjoin the report of the Harbor Master of St. Louis, for the last three years, including all the items embraced in his return, viz:

Whole number of arrivals of steamboats for the year 1839,	1,476
Amount of tonnage,	213,193
" " lumber,	10,099,516
Cords of wood,	16,648
Shingles,	10,589,500
Number of arrivals of steamboats from January 1st, 1840, to January 1st, 1841,	1,721
Whole amount of tonnage,	244,185
Average tonnage,	142
Number of arrivals of flat boats,	56
" feet of lumber,	9,977,375
" cords of wood,	25,114
" shingles,	6,433,500
" staves,	467,250
" hoop poles	44,850
" rails,	8,950
Arrivals of steamboats from January 1st, 1841, to January 1st, 1842,	1,928
Tonnage,	262,681
Average tonnage,	136
Cords of wood at the wood landing,	4,596
Below the creek, about,	2,000
Feet of lumber,	9,550,528
Shingles,	8,512,710
Staves,	382,159

The number of boats owned in 1241 by citizens of St. Louis, was 83. When we remember how short a period has elapsed since St Louis started into important existence, and contrast her position then with what it is now, some adequate idea may be formed of the rapid strides which have been made in agriculture, manufactures and civilization within a few fleeting years by the portion of the great west with which St. Louis is so immediately connected. And yet she must be merely in her infancy as a city. Thousands of emigrants will pass beyond her this year, and locate themselves in the rich lands above, which invite their footsteps. Nay, new and wonderful cities will start into existence along the borders of the navigable water courses, perhaps for a thousand miles above her, and the wildest imagination, looking at that region of country now, would not, in all probability, be able to give even a faint outline of its appearance a century hence.—*Philadelphia Inquirer and National Gazette.*

RAILROADS.

It may, we think, be safely stated, that our knowledge of the ultimate value of railroads, is, as yet, comparatively nothing. We see only the effect of infant energies and incipient efforts, and as we cannot tell what may be the mature developments, even of the most promising child, so, neither can we, at present, say what shall be the future and mature value of that system of intercommunication of which we are now enjoying but the earliest fruits.

We look upon what has been done, as but so many corroborative experiments of what may yet be accomplished, and as so many incitements to further and more enlarged operations. Our lines of railroad have hitherto been short, spanning small tracts of country, and uniting only proximate cities. We have hardly begun to try the effects of a long, unbroken chain, uniting many districts, many cities, many interests, many states;—linking the sea shore to the mountains, the mountains to the valleys, and the valleys to the head waters of its navigable streams.

The progress of "The Great Western Railroad," which is so rapidly connecting Boston with the "Far West," is the most daring enterprise of the kind which has been started, and will, we are assured, by its success, call into being schemes equally far-reaching and attractive. There must be other Atlantic outlets for the West, besides Boston. Its western railroad cannot become to the great Valley a "Mississippi" of railroad, making the whole West tributary to its channel; its business must inevitably be divided between the Atlantic sea ports, and Savannah asserts her claim to a portion under advantages which ought not to be overlooked. There is not a city south of Baltimore, more favorably situated for enlisting a large share of the trade of the West and South West than this city, and if the facilities offered can be seized upon and improved; if the interests of the people, not of the city merely, but of the state could be enlisted for the enterprise; if the popular and legislative energies of this Commonwealth could be converged upon this point, a highway of steam might, in a short time, be thrown up between those distant sections, which would enhance the agricultural, commercial, social and political advantages of each. It is true that the prospect of the carrying out of such a plan is not at present very bright, but that does not prevent our hoping for better things, and occasionally calling the attention of our citizens to an enterprise, which, before many years, we hope to see uniting in iron bands the "Father of Rivers," with the seaboard of Georgia. It is pleasant, sometimes, to send out our thoughts in advance of the times, and while the age is halting in doubt and embarrassment, to let them, like the spies of old, revel in the land of promise, and bring back from it those rich fruits and those good reports, which shall stimulate us to go forward and enter upon their possession.

Georgian.

RAILROAD CARS.

We observed a few days ago, a train of six beautiful railroad cars from the manufactory of Mr. Davenport, at Cambridgeport, capable of accomodating about 50 persons each, passing over the Boston and Worcester railroad, destined to Rochester. We were struck with the facility with which these large vehicles could be transported to such a distance, on an inland route. They probably reached

Rochester on the day after they left Boston, a distance of more than 400 miles, and without being removed from the railroad track, except for the purpose of being transported across the Hudson at Albany. We find the following announcement of the arrival of these cars, in the Rochester Evening Post.

Modern Luxuries—Magnificient Railroad Cars.—Yankee ingenuity is rarely more pleasantly exemplified than in the luxurious arrangements for railroad travelling, of which we have now in Rochester, a magnificient specimen—in the splendid train of passenger cars just launched for the service of the sovereign people, on the Auburn and Rochester Railroad.

There are six cars, designed to form two trains. The cars are each 28 feet long and 8 feet wide. The seats are well stuffed and admirable arranged—with arms for each chair, and changeable backs that will allow the passenger to change "front to rear" by a manœuvre unknown in military tactics. The size of the cars forms a pleasant room, handsomely painted, with floor matting, with windows secured from jarring, and with curtains to shield from the blazing sun. We should have said *rooms;* for in four out of six cars, (the other two being designed only for way passengers,) there is a ladies' apartment, with luxurious sofas for seats, and in recesses may be found a washstand and other conveniences. The arrangement of the apartment for ladies, we consider the greatest improvement; and it will remedy some serious objections that have hitherto existed against railroad travelling on the part of families, especially where any of the members are in delicate health. The ladies can now have their choice either of a sofa in their own apartment, or a seat in the main saloon of the cars, as their health and inclination may require.

These cars are so hung on springs, and are of such large size, that they are freed from most of the jar, and especially from the swinging motion so disagreeable to most railroads.

The lamp of each car is so placed as to light inside and out; and last though not least, the breakers are so arranged as to be applied readily and with great power—thus garding against the danger of collisions, etc.

On the whole it would be difficult to imagine any improvements that could be desired, though we dare say, these down-easters will rig out some new "notions" ere long, which will furnish "board and lodging" as well as a mere passage on the railroads.—"The cars are worth a sight, even if one has neither time nor money (as some of us printers have not) to indulge in the luxury of a ride.

We mention these matters with satisfaction as indications of the strong desire manifested by the Auburn and Rochester railroad company, to render their line of conveyance as satisfactory as possible to the travelling public.

N. B.—We almost forgot to mention that these beautiful cars were made by Davenport and Bridges, of Cambridge, Massachusetts, and cost at low prices about $1700 each—or $10,000 for the six. This firm keeps about one hundred men in employment and have orders on hand now for some eight hundred cars of all sorts. Mr. Bridges is now here on a visit.—*From the Boston Patriot.*

THE BOSTON AND WORCESTER RAIL ROAD.—The Directors of this railroad have presented their 14th annual report. The following is a brief abstract from the Boston Daily Advertiser:

"The new stock created by vote of the stockholders has been taken up with the exception of a few shares. Twenty miles of the new track are now in use from Needham to Westborough. It is proposed to extend this tract, this season, from Needham to Newton Corner, and from Westborough to Grafton. Iron will be imported for this work, and the whole will be ready to lay down next season. Measures will be taken to render the track permanent, by the introduction of a gravel foundation in many of the wet and clayey parts of the road. A great proportion of the sleepers which were laid down on the first completion of the road, are decayed and require removal. To supply their place with new ones, funds have been reserved from year to year. The number of new sleepers required to be laid this year, will be about 26,000 —being about the same number as were required last year.

Four daily trains have run regularly the last year, besides two freight trains. The trips of the ordinary trains, which stop ten times in the course of 45 miles, are made in two and a half hours, and those of the steamboat train, which makes but one stop, in two hours.

The amount of income during the year ending on the 31st day of December last, was $310,807 80; and of expenditures, $162,-998 58, making a net profit of $147,808 29. The receipts from passengers in the six months, to the commencement of the present month, amounted to $81,029 80, and the earnings from freight in the same period, $61,012 55, making a gross income from these two sources, of $142,042 35. This is an increase compared with the income from the same sources during the corresponding period of last year of $24,143 72, of which $16,983 is on passengers, and $7,160 on freight. The amount of expenses for this half year is not yet made up.

The Directors express themselves highly satisfied with the present condition of the road.

THE FUMIGATIAG HOUSE OF ODESSA.—The house for fumigating the luggage was a short distance from us. The room in which this took place is large enough to contain a portion of each person's but the system was bad, and a want of activity was evinced in the late hours that were kept, for no one was stirring before ten o'clock. When the director was seen, a rare occurrence, he appeared to flit by us like a jack o'-lantern. The men employed in the fumigating department were dressed in suits of coarse leather, and gloves of the same. Their dexterity in opening trunks and finding out secret drawers was quite amusing. The Bramah locks opened as if by magic, and Mr, Chubb would here have lost his premium. Such was the severity, and the extent to which it was carried, that hair in rings, brooches and lockets were taken out, and the lining of the dressing cases as well as the carriage cushions, were ripped open. Every article of metal as well as silk that was submitted to the action of the chloride was injured, and several of my antique lamps in "terra cotta" were broken. The "traiteur," an old Italian, was the only decent fellow about the place, and supplied us with linen and bedding, for the rooms were entirely without either. His wines were very fair and charges moderate. The revenues of the establishment must be great, for even the situation of "restaurateur" is farmed, and besides the charge for the rooms there was one trouble a day to pay for the guardians. Six month's rent at the rate we paid for two rooms, would have built the house.—*Captain Jesse's Notes of a Half-pay.*

Academy of Sciences.—The greater portion of the time occupied by the two last sittings was engrossed with the reading of papers on abstruse science; but some communications were read, which were not without interest beyoud the comparatively limited circle of those who devote their time to elementary investigations. A paper by M. Regnault, on dilating powers of gases, and on the relative powers of air and mercurial thermometers, was listened to with great attention. The object of M. Regnault in the experiments, of which he has given an account to the Academy, was: first, to study the dilation of gases within the same limits of temperature, but under different amounts of pressure; secondly, to ascertain the dilation of air in elevated temperatures, measured by means of the mercurial thermometer. As regards the first problem, it is the generally received opinion of natural philosophers, that the dilatation of gaceous matters is always the same, within the same limits of temperature, whatever may be the pressure to which they are subjected. M. Regnault, in order to test this doctrine, performed a series of experiments on the same volume of gas under the same or different degrees of temperature, and the result of them is, that the dilatation of air or other gas under pressure is more or less pronounced, according to its density. As regards the second problem, viz. the comparative power and correctness of the air and mercurial thermometers, he finds that up to 100 degrees there is no variation of sufficent importance to be worthy of consideration. Beyond 100 and up to 250 degrees, the variation is also small; at 300 the difference is one degree; at 325 degrees it is 1 degree 75; and at 350 the difference amounts to 3 degrees,

Corn Oil.—The Buffalo Commercial Advertiser, in relation to a paragraph on Corn Oil, which appeared in the Traveller some time since, says:

"Corn Oil is only obtained during the fermentation of the meal, preparatory for distillation, in the manufacture of whiskey. It rises on the surface of the beer in the mashing tubs or vats, and is taken up with a ladle. Twenty bushels of corn seldom yield more than six or eight quarts of oil. It is only in large distilleries that oil enough can be saved to render its preservation any object. Many attempts have been made to express oil from corn, by a process similar to that pursued in the manufacture of linseed oil; but hitherto, not enough has been obtained to render the business profitable."

Railroads in Germany.—It is said that the system of public improvement is making wondrous progress in Germany. Rail roads are established in every quarter. The little kingdom of Wertemberg, with a population of not quite two million, proposes to lay out fifty million of florins (a little over twenty million of dollars—in rail roads alone; and a number of canals and railroads are also in progress.—*Am. Traveller.*

The Danville Democrat says:—The Columbia Anthracite Furnace, which we stated had been blown out, is in perfect and sound condition. She had suffered nothing during the fifteen months she has been in blast, and we understand, that if she should be blown in again towards fall, it will be done on the same hearth, and without any alterations or repairs in the stack. This is another evidence of the complete success of the new method of smelting iron ore with anthracite.

Enormous Profits from some of the Mines in England.—The increased consumption of gas in all metropolitan cities, the vast number of steam ships of war, sailing to and from the ports of the old world, and upon the seas in every clime, has caused an immense and permanent demand for soft coals. An extra number of hands have been employed in all the principal colleries, and the proprietors of the best coal-fields in the territory of Great Britain are heaping up princely fortunes, from the profits of their business. We have heard of one individual, who has made between four and five millions, during a few years past, from the mines owned by himself alone.—*Am. Traveller.*

Western and Atlantic Railroad. We understand that the chief Engineer of the Western and Atlantic railroad has started on to the north after Iron for a track, and engines for the cars for the road. They have been for some time laying down the timber on the other end of the road, and will in a few brief months, be prepared to receive the cars for the first fifty miles. In the mean time the grading on this end of the road is gradually but regularly coming to a completion. Thus, in despite of the obstinate opposition which the road has had to encounter from its projection, and the unprecedented decline of State Stocks, the friends of the grand enterprise are permitted to exult in the fair prospect of the successful completion of the road at no distant day.—*Chattanooga Gazette.*